Southern Alberta Landscapes

MEETING THE CHALLENGES AHEAD ▶▶

Input-Output Model

Prepared for
Alberta Environment
By Suren Kulshreshtha
and
Russell Consulting
March 9, 2004

Alberta

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1 INTRODUCTION

When a change in sector production occurs, the impact of the change is felt through other sectors in the regional and provincial economy. Various firms in an economy constantly adjust to resource availability, new technologies, globalization, international trade. Other impacts on individual sectors in an economy include changes in: monetary (interest rate shifts), fiscal (taxes and subsidies) policies, tax reforms, and other domestic policies. This results in some firms maintaining their market share, while at the same in some sectors, new economic activities begin to appear and in some cases some existing processes cease to exist. As changes such as those listed above happen, impacts are felt in the firms most directly involved. However, these impacts do not show the total picture. Associated with these direct changes are the ripple effects created by these firms. These ripple effects affect other local firms in the region, firms located in farm regions through domestic and international trade, and through adjustments in households' consumption expenditures. Estimation of the ripple effects from a given change in sectoral output are typically captured by using an input-output model (I-O) of the economy.

In the context of this study for the Southern Alberta Sustainable Strategies (SASS) region, it is planned to estimate impacts of alternative development scenarios on the SASS regional economy over the next 50 years period. Over such a long period, certain economic activities would likely expand from the current levels, while in the case of activities dependent on natural resources, their level may even decrease. All of these changes would have a ripple effect on other sectors within the SASS region. The role of the I-O model is to estimate the extent of these ripple effects on the economy and on employment in the region. The Alberta Landscape Cumulative Effects Simulator (*ALCES*) model is used for simulating the physical changes in primary sectoral output over this period.

ALCES is a computer program designed to simulate natural and economic changes in the landscape. It is built upon *STELLA*, a computer program that takes a plumbers' view of natural systems (stocks and flows). Stocks represent levels or amounts of things. These levels are controlled by inflow and outflow rates. Stocks in *STELLA* are aspatial, and consequently the results cannot be explicitly mapped. Spatial land cover data, including both natural and anthropogenic elements, are organized into desired cover types and footprint types for the entire study area, and then entered into a data sheet for processing. *ALCES* for SASS contains 29 natural cover types including forests, shrublands, grassland, agriculture, water, and non-vegetated categories, and 21 footprint types including transportation, energy, residential, mining and other an assorted category. Future changes in the area of each cover type due to anthropogenic factors can be simulated. *ALCES* calculates changes in the area of each cover type and updates the total area of cover types during each time-step of a simulation. The results can be shown as graphs or tables, or used in *ALCES* for calculating desired outputs such as oil, natural gas, timber, beef, grains, oilseeds, etc.

In order to estimate regional economic impacts[1], in terms of levels of production of the various sectors, and other related economic changes in the SASS region, a number of modeling activities are required. An overview of this process is shown in Figure 1.

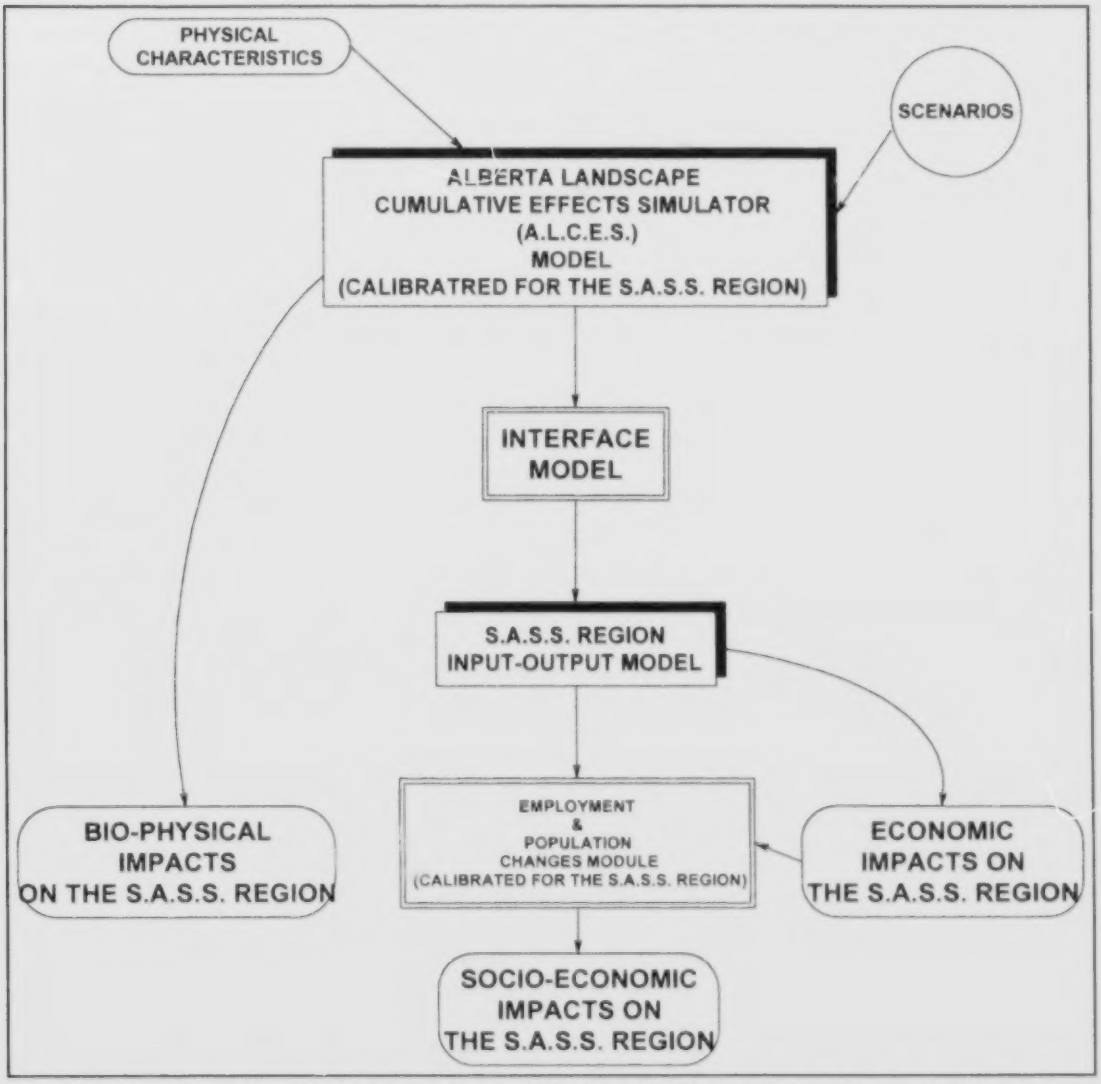
PHYSICAL CHARACTERISTICS
SCENARIOS
ALBERTA LANDSCAPE CUMULATIVE EFFECTS SIMULATOR (A.L.C.E.S.) MODEL (CALIBRATRED FOR THE S.A.S.S. REGION)
INTERFACE MODEL
S.A.S.S. REGION INPUT-OUTPUT MODEL
BIO-PHYSICAL IMPACTS ON THE S.A.S.S. REGION
EMPLOYMENT & POPULATION CHANGES MODULE (CALIBRATED FOR THE S.A.S.S. REGION)
ECONOMIC IMPACTS ON THE S.A.S.S. REGION
SOCIO-ECONOMIC IMPACTS ON THE S.A.S.S. REGION

Figure 1: Overview of the Input-Output Model with Interrelationships and Impacts

[1] The reference to the region in this study is to the Southern Alberta Sustainable Strategy region, which is defined along with the model description.

The analytical activities that are envisaged to be developed in order to estimate changes in various socio-economic[2] impacts in the region include the followings:

One, Since results of the ALCES model are in physical units, these need to be converted into units recognized by the input-output, model. This requires the development of an 'Interface Model' to translate the physical changes into value terms.

Two, The SASS region-specific input-output model needs to be developed, that is capable of estimating all ripple effects created by various economic changes generated by the ALCES model.

Three, Economic changes in the level of economic output of various firms / group of firms (called sectors) needs to be translated into changes in employment, and subsequent changes in the population of the SASS region.

The purpose of this report is to describe the development of these aspects of impact analysis of the SASS region.

The rest of this report is divided into seven chapters: Chapter 2 provides an overview of the input-output model and analytical processes. Chapters 3, 4 and 5 are a description of the development of the I-O model and processes for the evaluation of various scenarios in the SASS study. Chapter 6 describes the procedure to be followed to undertake economic impact analysis using the ALCES – Interface Model with the appended Employment Module. Chapter 7 is a summary.

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2 Socio-economic impacts to be monitored in the region include: Value of sector sales, sectoral gross domestic product (GDP), income, and employment.

2 OVERVIEW OF ECONOMIC IMPACT ASSESSMENT

If one is engaged in regional economic impact analysis, one needs to have a clear understanding of the region as it is, its various economic activities, its dependence on other regions to meet its needs, the nature of interdependence amongst various types of economic activities, and how the future of the region might look like under alternative policy regimes or development paths. One faces questions like these: What is the importance of a sector, such as irrigation production? How large contribution is made by the resource sectors in the region? How much government revenues (indirect) are generated by the processing of raw materials of agricultural origins? The models described in this report have the capacity to address these questions.

2.1 Need for an Input-Output Model

If one lives in a region with a single sector, that is export oriented, economic impact assessment will be rather simple. For these situations, an Export Base model is adequate. This model relates the total growth in the region to the export sales. Higher the export levels, higher is the economic performance of the region. The only driving force in the region is the export market, on which the region has no control; it is decided by forces outside the region.

The above type of model would only be appropriate for a single sector region. An example of this type of a region would be a mining town, where the ore is sent elsewhere for processing or processed alongside, or a town totally dependent on tourism. Unfortunately in the twenty-first century, not too many regions resemble this type of a simple region[3]. Most economic activities in a region are undertaken by a number of sectors. These sectors trade with each other. Each sector can produce a number of products. For this type of an economy, the best way undertake economic impact assessment is through the use of an input-output model.

An input-output model is a useful method of estimating secondary impacts of economic development projects. Secondary impacts in this context refers to any other changes, beyond those experienced by the sectors that are affected by a given initial change. An input-output based economic impact analysis is preferred for the following reasons:

One, every sector's impact is treated to be unique, allowing its specific economic impacts to be estimated.

Two, different types of economic stimulus can be applied to undertake economic impact analysis. Thus, economic impacts of consumer spending, exports, or purchases by other sectors, for example, could be estimated uniquely.

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[3] This should not be interpreted that in southern Alberta such economies do not exist. Small towns that rely totally on tourism or a single mine (whose output is exported) are examples of such a region.

Three, development of the model can also be region specific, thereby allowing regional differences in the production processes, technology and trade patterns.

2.2 An Input-Output Model[4]

An input-output model is a representation of economic activities in a state or a nation. It attempts to quantify, at a point in time, the economic interdependencies that exists in the economy. In these models, all economic activities are divided into one of two types of sectors – production sectors, or final demand sectors. A producing sector is comprised of firms that produce similar goods and services using a similar technology of production. Production sectors (such as agriculture, mining, manufacturing, construction) represent establishments in the region that produce a product or service for use either by another sector or by final demand sectors. The level of activity of these sectors is endogenized (determined within the model). Sectors representing final demand are generally the household (or consumers), governments, and foreign trade. Level of activities of the final demand sectors is exogenous to the model. All changes in the production sectors of a region are therefore, the result of the changes that occur in the exogenous sectors.

2.2.1 Assumptions of the Input-Output Model

An input-output model is based on several assumptions. The following ones are particularly noteworthy:

1. Constant Technology and Fixed Technical Coefficients Assumption. Under this assumption, the input structure of a sector remains fixed. In other words, the input structure does not change during the period of analysis. Inputs are used in constant proportion to output. Doubling the output implies doubling input of each input.

   This assumption has four implications:

   (a) No allowance is made for technological change which could alter factor-factor or factor-product relationships;

   (b) Sectors cannot substitute inputs from one sector for inputs from another sector;

   (c) There is no scale or size economies of production; and

   (d) The relative prices of all goods and services remain constant.

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[4] More details on these models can be obtained from Miller and Blair (1985), Davis (1993) and in Otto and Johnson (1993).

2. Homogeneity of Sectors: The concept of a sector or industry in an input-output model is fundamental in constructing an empirical model. In reality there are many and diverse type of economic activities, which are not homogenous either in terms of the product produced or the nature of production technology used. Since it is not possible to have a separate sector for each of these economic activities, grouping them into sectors is devised. In this aggregation process, an assumption of one product one production process is made.

3. Additivity and Divisibility: The outputs of various firms are assumed to be additive to form the regional output. Thus the assumption that the total effect of several different activities is the sum of their separate effects is made. Furthermore, it is assumed that the output of a firm included in the sector is completely divisible. Thus, it is possible for a sector to produce any incremental change.

Additional assumptions that are needed to use the SASS I-O model include the following:

A.4 The technology used by the firms remains unchanged with the change in the level of output. In other words, the technology coefficients are fixed and do not change with the level of production.

A.5 Each sector produces various goods in a fixed proportion. Doubling of output for a given good translates into all firms producing that good to double their output.

A.6 The model assumes no supply constraints; if demand is present, the economy will gear up to meet the required quantity of goods and services.

Although some of these assumptions are often violated in reality, this does not negate the usefulness of the input-output models. In most regional models, the aggregates are sufficiently large to minimize any departure from reality imposed by these assumptions.

2.3 Transactions Table

The heart of an input - output model is a 'Transactions Table'. This table presents all the sales and purchases of commodities by various 'sectors'. To make a model manageable, number of sectors are typically restricted to a smaller number. Any of the goods and services produced by a sector are called 'commodities'. A commodity can be a good or a service that is needed by other sectors in the economy.

A typical transactions table has four major components. A rudimentary transactions table is shown in Figure 2.2 Transactions are permitted among various goods producing sectors, or between goods producing sectors and the final demand sectors. Accordingly, the columns in the transactions table are divided into two types of purchases: One, various firms in the region that need some raw materials from other industries. These are called intermediate purchases or sales; Two, purchases

by final demand agencies, called final sales. The distinction between the two types of purchasers is simple: Intermediate sales are for further value added. These products will enter into the economy but in a somewhat modified shape or form. The final demand agencies purchase goods for final consumption – they are not allowed to enter back into the economy again. Four types of final demand agencies are typically included in the transactions table: consumers, government expenditures including investment, business investment, and exports.

Selling Sectors	**Purchasing Sectors**		**Total**
	Firms / Industries	**Final Demand Agencies**	
Firms / Industries	Sales of goods and services by one firm to the other firms **(Intermediate Demand)**	Sales to consumers, government, businesses for investment, and for exports **(Final Demand)**	Total Output of Firms
Primary Resource Owners	Payments by firms to workers, capital resource owners **(Value Added by Industries)**	Payments by final demand agencies to workers, capital resource owners **(Value Added by Final Demand Agencies)**	Total Value Added
Total Sales	Total Sales of Firms	Total Final Demand for Various Agencies	

Figure 2:2 An Overview of a Transactions Table for a Square Input-Output Model
On rows are shown various industries / agents that sell their goods and services. These are also divided into two broad categories of sellers: One, industries that have goods and services for sale to either other industries or for final consumption; and Two, owners of labor and capital resources that are needed in the production of goods and services by various industries and / or by final demand agencies for the delivery of their goods and services.

The last row provides the total inputs or purchases by the various agents / firms, while the last column shows the sales of the industries, and the value added (gross domestic product) for the region. It should be noted that all industries are in perfect balance – their sales always equal purchases. If they do not, on account of inventories or other factors, adjustments are made to balance the economy.

2.4 Square vs. Rectangular Input-Output Models

In a square input-output model, a goods producing sector is allowed to produce one, and only one, commodity. Thus, a sector sells one product. Thus, the number of selling sectors is equal to the number of goods producing sectors. The transactions table for the production sector is square in format, and the model is called a square input-output model.

The input-output table shown in Figure 2.2 assumes that each industry produced a single commodity. Thus, the number of industries (sectors) and number of goods and services are identical. This type of accounting system is called a square input-out model. When this assumption of producing a single good or service by each industry (sector) is relaxed, the model is called a 'Commodity by Industry' input-output model. An alternative name for this type of model is rectangular input-output model[5].

In a rectangular input-output (I-O) model, an industry (belonging to a given sector) can produce a number of goods (called commodities). Typically, the number of goods produced are higher than the number of economic sectors. Each of the commodity's demand and supply is accounted separately from the sectoral accounts. An accounting framework for the rectangular input-output table is shown in Figure 2.3.

In the rectangular I-O model, in addition to the sectoral accounts (similar to the square I-O model), there are additional commodity accounts. Commodity output and sales are traced within the economy through two accounts: (1) Output or Make Matrix, and (2) Input or Technology Matrix.

(1) Output / Make Matrix: The production mix of various sectors is included in the output matrix, also known as the Make matrix. The "Make Matrix" shows the composition of production of various commodities in the region. In other words, various sectors that produce that commodity are listed an their share of the total market supply recorded.

(2) Input / Technology Matrix: The input matrix presents the requirements for various commodities for the production activity undertaken by various sectors. Such requirements are determined by the nature of production function for these sectors, and therefore, another name for this matrix is Technology matrix. These requirements are also called intermediate sale, since these are required to produce the final product sold to consumers, government sector, investment, or for exports by these sectors. This matrix is identical to the intermediate sales matrix in the square I-O model (except it is in commodity by sector space, as against sector by sector space in the square model).

Similar resemblance also exists for the other accounts – primary inputs and final demand agencies, with one exception. The unit of transactions is in terms of value of commodities as opposed to

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[5] For a detailed description of these models, see Hoffman and Kent (1975),

physical output.

	Commodities	**Sectors**	**Final Demand Agencies**	**Total**
Commodities		Intermediate Sales (Input or Technology Matrix – Commodities)	Final Demand for Commodities	Total Commodity Sales
Sectors	Production of Commodities (Output or Make Matrix)			Total Output of Sectors
Resource Owners		Purchase of Primary Resources by Firms	Payment by Final Demand Agencies to Primary Resource Owners	Total Value Added
Total	Total Commodity Output	Total Inputs of Sectors	Total Final Demand Transactions	

Figure 2.3 An Accounting Framework of a Rectangular Input-Output Model

2.5 Nature of Impacts in an Economy

When a sectoral change occurs in an economy, two types of impacts are obvious – direct impacts, and secondary impacts. Direct impacts are those that are experienced by a goods producing sector directly because of the change. For example, if the exports of live hogs increase, on account of higher demand in the U.S., the hog producers will be the one facing the initial gain. They will be called the direct impact sector. Other direct impacts may include occurrences such as, consumers spending more money (through less savings) or through higher income resulting from more jobs being created. Or, there may be a sudden increase in the foreign demand for a certain good, or simply a decision by the government for a new investment.

Secondary impacts are created by the direct impacts. They are the second, third, etc., rounds of economic ripples created by the direct change in the economy. Since these are felt by sectors other than those experiencing direct impacts, secondary impacts are called an economic externality. Whatever the source of the direct impact, there will be secondary impacts created by it, unless of course, the change results in all money being spent outside the region.

Secondary impacts, as shown in Figure 2.4, are generated through two types of linkages: (1) Backward linkages, and (2) Forward linkages. Backward linkages are those where the industry experiencing the direct change, adjusts its purchases of raw material from other industries along with adjustments in the level of primary (land, labor and capital) resources.

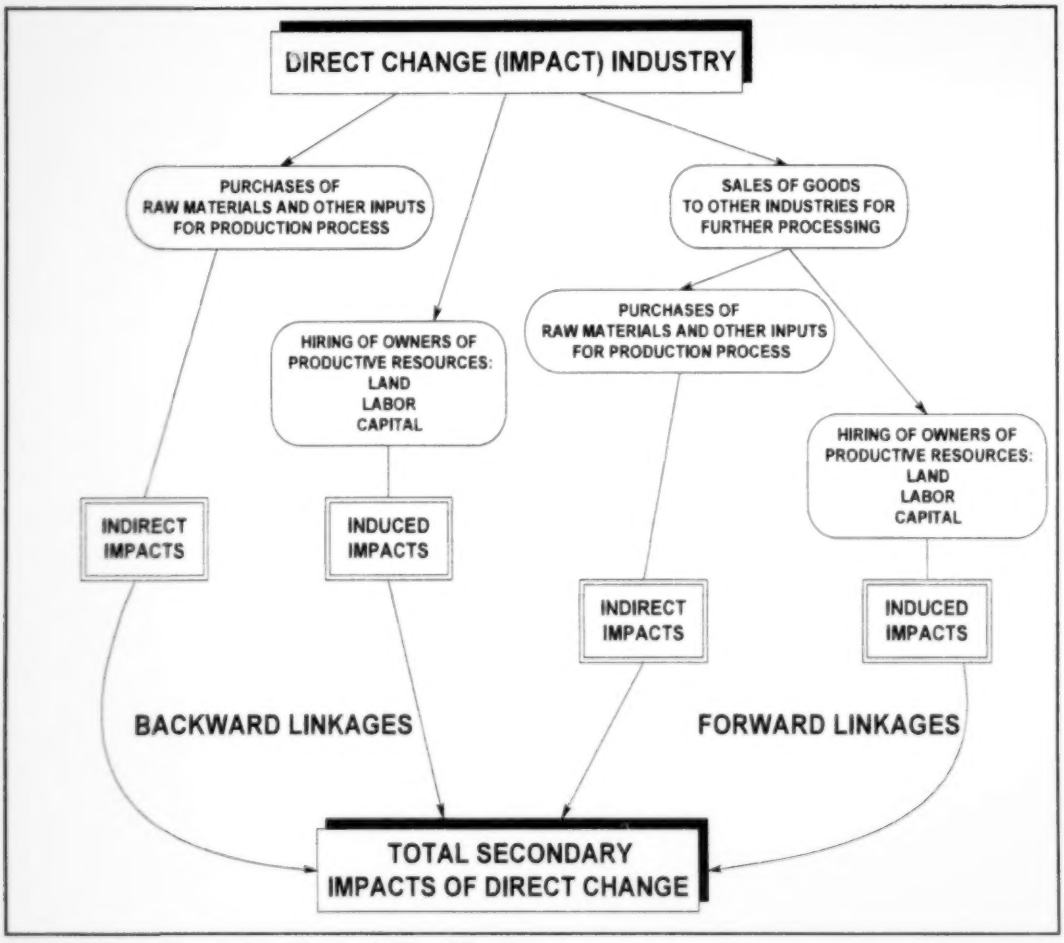
DIRECT CHANGE (IMPACT) INDUSTRY
PURCHASES OF RAW MATERIALS AND OTHER INPUTS FOR PRODUCTION PROCESS
SALES OF GOODS TO OTHER INDUSTRIES FOR FURTHER PROCESSING
HIRING OF OWNERS OF PRODUCTIVE RESOURCES: LAND LABOR CAPITAL
PURCHASES OF RAW MATERIALS AND OTHER INPUTS FOR PRODUCTION PROCESS
HIRING OF OWNERS OF PRODUCTIVE RESOURCES: LAND LABOR CAPITAL
INDIRECT IMPACTS
INDUCED IMPACTS
INDIRECT IMPACTS
INDUCED IMPACTS
BACKWARD LINKAGES
FORWARD LINKAGES
TOTAL SECONDARY IMPACTS OF DIRECT CHANGE

Figure 2.4 Secondary Impact Classification

Let us take an example of ecotourism. If the ecotourism industry in the SASS region were to increase it's volume of business, there will be more hotels and food services, and more transportation activities will result. Hotels and restaurant sector would hire more workers, as well as purchase more food products, textile products, and other required inputs. All the sectors producing these commodities would receive a boost in their demand, and would gear up to produce them. This process would continue until all industries have adjusted to meet the new target level for increased ecotourism in the sector. These industries will be affected because of the ecotourism industry, and thus, are considered to be linked in a backward manner (meeting the needs of the industry).

Forward linkages are those transactions in the economy where an industry sells its products to another industry to generate further value-added (through further processing) activities. An example of this linkage is between livestock industry, say the confined livestock operations, and livestock slaughtering plus meat processing industry. Livestock slaughtering industry demands livestock as the major input. In addition, this industry would purchase other inputs that are needed for the production of meat and meat products, including packaging material, machinery and equipment, etc. Thus, the livestock slaughtering industry is linked in a forward manner with the agriculture industry. The livestock slaughtering industry determines the demand for livestock. Thus, purchases of goods and services by one sector from other sectors constitute one type of economic impacts in the economy.

In addition to the sales of goods and services in response to a demand for them by other industries, another type of impact occurs as a result of the direct impact. Frequently a direct impact involves hiring workers for undertaking the additional economic activities. These workers receive wages and other remuneration for their services. In addition, the firms also make some profits that are distributed to owners of the resources. These individuals, being consumers, would likely spend this additional money on consumer goods. This will result in increased demand for consumer goods, and would lead to industries gearing up to producing additional goods to meet his demand.

Both industrial and consumer demands affect the total impact of a direct change on any one sector of an economy. This is the essence of the input-output analysis. Total economic impacts can be defined as follows:

Total Economic Impact	=	Direct Impact	+	Secondary Impact	(2.1)

We can also divide the total secondary impacts into two basic types of changes under each of the linkages that exists in an economy: (1) Indirect impacts, which are generated though the demand for additional production goods and services that are needed by the directly impacted industry. (2) Induced impacts that are a result of consumer spending enabled by the increased wages and salaries from the higher employment generated under the indirect impacts. Thus, total secondary impacts can be decomposed into four components:

(1) Indirect impact from backward linked industries;
(2) Indirect impacts from forward linked impacts;
(3) Induced impacts through backward linked industries; and
(4) Induced impacts from forward linked industries.

Total impacts are then simply a sum of direct changes and secondary changes.

2.6 Estimation of Secondary Impacts

A fundamental relationship of an input-output analysis is that the level of goods and services produced by a sector in the region is determined by the amount purchased by all users of that good or service. Thus, the analysis is 'demand-driven'. The production sectors will gear up to changes in final demand sectors. Assumption of no capacity constraints for any production sector is made. In other words, if demand exists, supply will follow.

It is assumed in an input-output analysis, that equilibrium conditions exist. This means that under all circumstances, supply equals demand. Since this is impossible for certain industries, adjustments are made in the demand side to force a balance. This is accomplished by adjusting the demand for various goods that are met from local production as against that provided by imports (called leakages). The higher the amount of imports, the lower the impact of the direct changes on various economic sectors. Other adjustments that are made include inventory changes. Since change in the inventory is a withdrawal from past production, it is netted out of the demand (since a portion of the demand is not being met from current production and therefore, has no economic impact).

In order to undertake economic impact analysis, the rectangular I-O model needs some further manipulation. This involves solving the output of a sector (or a commodity) being related to the final demand of various commodities. This is done by using the information in the 'Output matrix' and the 'Input matrix', presenting it in coefficient form, and solving the systems of equation for sector output (or commodity output). The final equation for the estimation of impacts is as follows:

Sector Output	=	Sectoral Multiplier Matrix	*	Final Demand for sector(s)	(2.2)

Similarly the system can be solved for commodity output as follows:

Commodity Output	=	Commodity Multiplier Matrix	*	Final Demand For Commodities	(2.3)

An I-O model based multiplier is analogous to an aggregate multiplier for the economy as a whole, for all sectors considered together. The only difference is that it is now more specific to the sector in question.

A multiplier is simply the number of times a dollar spent by one sector is re-circulated in the economy. This re-circulation is a result of re-spending of the money spent by the sector that is impacted first. In the ecotourism example, increased ecotourism would likely result in increased sales of hotels and food services goods and services first. This is the first round of expenditures, typically called the direct impacts.

The second round of expenditures begins with these industries spending this money on goods and services needed for their operations. For example, they would likely spend more money on paying workers, buying groceries including agricultural products, purchasing various goods needed for the maintenance and operations of the hotel, and so on. The third round of expenditures begins with the actions of groceries stores, and other industries selling inputs required for the operation of the hotel and restaurants. For example, grocery stores would spend this money on wages and salaries to their workers, purchasing farm products, or meat product (among a variety of foods), as well as other needs. The next round of reaction would start with the actions of the farmers (who have sold their products to the grocery stores). This payment received by the farmers would be spent on the production of various foods products, and a portion of that money being retained as returns to producers. This process would continue until all the sectors in the region have spent the money. If one were to sum all these expenditures and express them on a per dollar of the first round change, one derives the value of multiplier. Thus, a multiplier is simply the strength of the re-circulation of the initial expenditures within the economic system.

Multipliers can be calculated with respect to a unit change in the final demand (classical form of multipliers) or with respect to a change in output (called pseudo multipliers). In addition, a ratio-from multiplier can also be calculated where it reflects the total change in the economy for a given economic indicator (such as GDP or Income) for a unit change in the same economic indicator.

Various economic indicators for the economy are related to the level of output in fixed proportions. An increase in the output means a fixed proportion of this amount is value added (gross domestic product – GDP), or household incomes, or imports.

GDP Contribution for a Sector	=	Proportion of GDP to Output of the Sector	*	Output of the Sector	(2.4)

Employment of workers can also be linked in a similar manner to the change in the output of various sectors. This requires estimation of employment - output ratios for various sectors in the model. Thus, as various sectors adjust their output in response to changing demand for their goods and services, its employment level also changes.

One word of caution is advised in interpreting results of employment changes related to final demand changes. As an industry gears down in production, it may not lay-off its workforce proportionally. Instead, there may be more job sharing or reduced work hours for some workers, particularly if the situation is seen as a short-run change. A situation of underemployment may thus, exist, which may lead to overestimation of loss of employment during periods of declining final demand.

2.7 Closed vs. Open Input-Output Model Systems

An input-output model can be solved with or without endogenizing the household expenditures. If consumers are not a sector within the multiplier matrix, the model is called an 'open' model. The economic impacts capture only those resulting from purchases of goods and services by various industries. The multipliers are called Type I multipliers.

If personal incomes and household expenditures are endogenized i.e., added as an additional row and column in the multiplier matrix, the model becomes 'closed' with respect to households. Thus, as income of the workers increases, their expenditures increase as well. The resulting economic impacts are called Type II impacts and include both Type I impacts plus induced impacts.

2.8 Regional Input-Output Models

Although the input-output model methodology was originally designed for a country as a whole, recent developments has facilitated building such models for the smaller than a country level. Two issues that are faced by the modeler in this respect include: One, how should interregional effects be included in the model? And Two, how should regional technology and production patterns be estimated.

Further consideration of the first issues leads to two types of models: Multi-regional input-output (MRIO) models and Interregional Input-output (IRIO) models. In the MRIO models, various regions within a country (or state) are represented with their respective technology and production patterns. However, they are not allowed to trade among themselves. In the IRIO framework, various regions produce not only produce goods and services, but also trade with each other in a reciprocative manner. Thus, a three regional IRIO model will contain nine different sets of coefficients.

The MRIO models are less data intensive and therefore, easier to build. The IRIO requires detailed information on the trade flows among various regions. Further more the size of the model also increases almost exponentially as more regions are added. For a ten region IRIO, there would be 100 data matrices to be created. Thus, these model become vary expensive to develop.

2.9 Summary

In summary, economic impact analysis for a region can be undertaken using a variety of input-output models. At the very base is the accounting system bifurcation – square vs. rectangular. Once decided then the question arises whether the model be a multi-regional (MRIO) in nature or inter-regional (IRIO) in nature. Then comes the question whether the model should be open or closed. Many of these questions are resolved in light of the objective of the analysis.

The model developed for the SASS socio-economic analysis is a rectangular multi-regional model. The model generates both type I and type II multipliers (open and closed).

3 METHODOLOGY FOR THE DEVELOPMENT OF THE SASS INPUT-OUTPUT MODEL

In this chapter, details of the selected study model are reported. The methodology followed in its construction are also detailed out. Development of various economic indicators using this model are included as well. In addition, the development of the employment module is also described in this chapter.

3.1 Specification of the Study Input-output Model

The study model, called the "**S**outhern **A**lberta **S**ustainable **S**trategy Region **I**nput-Output and **E**mployment Model" or **SASSIE**, was designed using the following considerations:

1. It followed the rectangular I-O model accounting framework. The reason for this was the availability of data for building this model.

2. It was multi-regional model with the province of Alberta divided into two regions: SASS Region, and Rest of Alberta region. The model was also designed for estimation of economic impacts on the province as a whole, if needed.

3. It was designed to estimate both households endogenous and household exogenous impacts. In other words, it has the capability of estimating both Type I and Type II multipliers for all sectors.

4. The input-output model was appended with an "Employment Module" to estimate, along with various economic indicators, change in employment by sectors, resulting from a given change in final demand under alternative development scenarios.

More details on the process undertaken for the construction of this model are listed below.

3.2 Basic Data Tables

The staring point for the development of the SASSIE was obtaining basic transactions tables for the province of Alberta from Statistics Canada. This included a total of three tables, one each for Inputs, Output, and Final Demand Categories. In the Input and Output related transactions, the Alberta Economy was divided into 25 groups of industries, called sectors. These sectors produced any one or more of the 51goods and services, called commodities. In addition, there were an additional two categories of imports and six primary inputs. In addition to the goods producing industries, there were 13 final demand categories in the model.

Various sectors, commodities and final demand agencies are shown in Appendix A. The transactions in these tables were for the year 1999. The following sections contain more information about these categories.

3.3 Delineation of the Region

The SASSIE model; was developed as a multi-regional input-output model. The province of Alberta was divided into two regions: (1) the SASS region and (2) the rest of the province. The boundaries for the SASS region were created using the list of census divisions (CD) shown in Table 3.1.

Table 3.1: Regions Included in the SASS Region

Region	Sub-region and Share of the Region	Employment in 1996
CD# 1 (Medicine Hat Region)	All	32,345
CD# 2 (Lethbridge/Brooks Region)	All	66,250
CD# 3 (Oldman/Waterton Region)	All	17,830
CD# 4 (Hanna/Oyen Region)	All	6,770
CD# 5 (Drumheller/Vulcan Region)	All	21,940
CD# 6 (Calgary Region)	All	497,145
CD# 7 (Castor/Coronation Region)	Paintearth County (80%) Stettler County (60%)	1,415 3,075
CD# 8 (Red Deer Region)	Red Deer County (100%) Red Deer City (100%)	9,900 32,695
CD# 15 (Rocky Mountain Region)	All	18,990
SASS Region		**664,277**
Province of Alberta		1,461,360
SASS Region % of Province		45.5%

The SASS region comprised of all counties and sub-regions in the southern part of the province. It include Census Divisions 1 to 6 and Census Division 15 completely. In addition, smaller portions of Census Divisions 7 and 8 were also included in the SASS region.

Once all the regions are accounted for, the next step was to estimate the size of the region, and its importance to the province as a whole. Employment data were procured from Statistics Canada[6]. Allocating the employment statistics for the SASS region, it is estimated that in 1996 the region employed a total of 664,277 workers. The Alberta employment for the same period was estimated to be 1.46 million workers. The SASS region thus, employed 45.5% of the Alberta workers.

3.4 Specification of the Economic Sectors and Nature of Goods Produced

Although the specification of the model by Statistics Canada is comprehensive, it was assessed to be somewhat inadequate to deal with the objectives of the present study. This is because the ALCES model is more disaggregated in the production of primary commodities. In order to bring forth similarity of scope for the two models, the input-output model was disaggregated further. It was needed in three original sectors: Agriculture sector, Mining sector and Manufacturing sector. These are described below. The disaggregated study model contained a number of commodities that were added to the list of original (Statistics Canada) model. The updated list of commodities is shown in Table 3.2.

3.4.1 Disaggregation of Agriculture Production

Agriculture in the SASS regions is dominated by three types of enterprises: Irrigation industry that produces a variety of products, including livestock, forages, and speciality crops; and Confined Feeding Operations (CFO), which include large scale feedlots, and intensive hog operations. In addition, the region has large number of farm units that produce various agricultural products using non-irrigated or dryland production methods.

The Statistics Canada's agriculture sector was disaggregated, by methodological tasks described in this section, into the three sectors: Dryland Production, Irrigated Production, and Confined Feeding Operations. Agricultural production in the province was estimated to be $7.2 billion in 2000 (the base year for the model). Using this method, the following breakdown was calculated for the SASS region. The SASS region produces a little over two-thirds of the total Alberta's agricultural production, as shown in Figure 5. A part explanation for this large share is the presence of irrigation in the region, that produces forages, leads to higher intensity (per unit of land) of cattle, and a large number of intensive livestock operations, particularly feedlots. Within the region, almost half of the value of agricultural production is contributed by the confined feeding operations, while another 16% is through irrigation activities (Figure 6).

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[6] These data were for the 1996 Census. Data were obtained on a Census Division level plus at the smaller disaggregations, including non-farm community (hamlets, villages, towns and cities) level.

Since the agriculture sector could purchase any of the 57 commodities shown in Table 3.2, some criteria for distributing these purchases to the three sub-sectors had to be devised. This was done by following two tasks, described below:

Task # 1: Estimated Crop Production Activity in The SASS Region

Census data for area under various agricultural crops by municipal regions are available for Alberta. The total value of provincial crop production by crop type are also available for Alberta.

Table 3.2: List of Commodities in the SASS Input-Output and Employment Model

No.	Description	No.	Description
1	Grains	30	Other manufactured products
2	Livestock and Poultry	31	Residential construction
3	Other agricultural products	32	Non-residential construction
4	Forestry products	33	Repair construction
5	Fish, seafood and trapping products	34	Transportation and storage
6	Metal ores & concentrates	35	Communications services
7	Mineral fuels	36	Other utilities
8	Non-metallic minerals	37	Wholesaling margins
9	Services incidental to mining	38	Retailing margins
10	Meat and meat products	39	Gross imputed rent
11	Dairy Products	40	Other finance, insurance, and real estate serv.
12	Fish, Feeds, Fruit, veg. and other food products	41	Business and computer services
13	Soft drinks and alcoholic beverages	42	Private education services
14	Tobacco and tobacco products	43	Health and social services
15	Leather, rubber, and plastic products	44	Accommodation services and meals
16	Textile products	45	Other services
17	Hosiery, clothing and accessories	46	Transportation margins
18	Lumber and wood products	47	Operating, office, cafeteria and lab. supplies
19	Furniture and fixtures	48	Travel & entertainment, advertising & promotion
20	Wood pulp, paper and paper products	49	Non-profit institutions serving households
21	Printing and publishing	50	Government sector services
22	Primary metal products	51	Non-competing imports

No.	Description	No.	Description
23	Other metal products	52	Unallocated imports and exports
24	Machinery and equipment	53	Sales of other government services
25	Motor veh., oth. transport equip. and parts	54	Indirect taxes
26	Electrical, electronic and communic. prod.	55	Subsidies
27	Non-metallic mineral products	56	Labour Income
28	Petroleum and coal products	57	Other operating surplus
29	Chemicals, pharmaceuticals & chemical prod.		

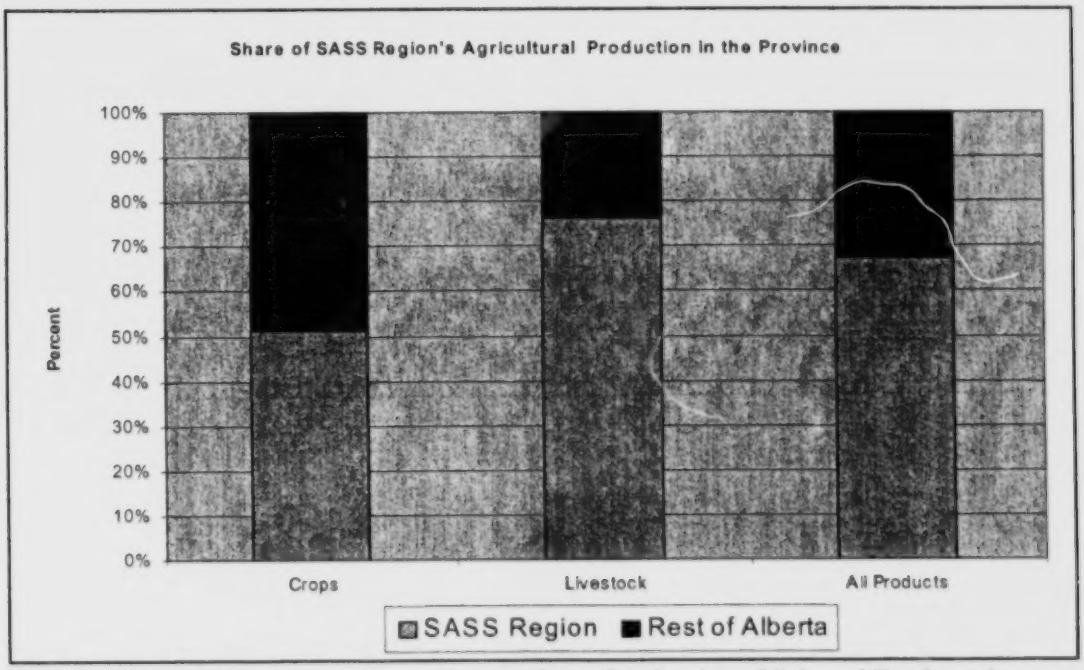

Figure 5: Distribution of Share of Agriculture Production of Selected Products in SASS Region, Relative to Alberta, 2000

Cost of production studies are available by irrigated and non-irrigated crop production and by soil zone. These cost of production studies include target yields. The product of target yields, crop prices, and areas under various crops is a ball park estimate of production. An adjustment of production levels was required such that the sum of regional production coincides with total provincial cash receipts. The adjustment was made as follows:

- Soil zones were spatially correlated with municipal regions to determine the appropriate cost of production statistics to apply to each region.
- Target yields for each soil zone were multiplied by crop prices to determine ball park value of production estimates which are then totaled up for the province.
- Yields were then proportionally adjusted for each soil zone including irrigation production, such that total production matched with total provincial cash receipts.
-

Soil zone data were then aggregated to determine total production for the SASS and non-SASS regions.

- Where soil zones overlapped the SASS regional boundary, data were proportioned by municipal district acreage statistics.

Farm operating and depreciation expenses were also required by region as input to the development

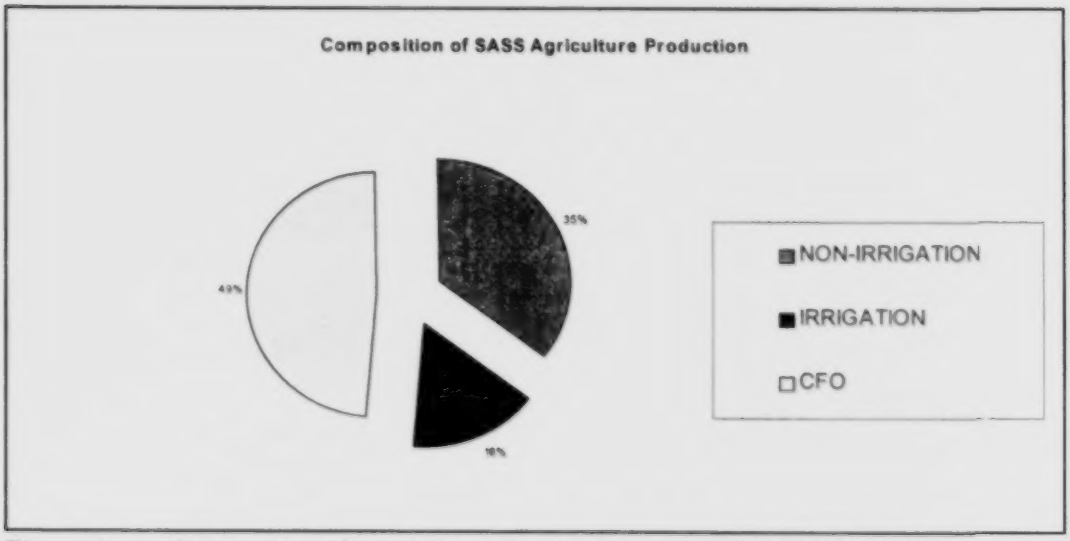

Figure 6: Composition of Agricultural Production in the SASS Region, 2000

of the regional agricultural sub-sectors. Each individual expense item was accumulated across soil

zones based on the cropped acres in each zone as estimated above and cost of production publications. [7] Total provincial expenses, as reported by Statistics Canada census data, were arbitrarily proportioned into crop and livestock expenses. The proportion of each expense category applied to crop or livestock production, is dependent on the type of expense. Total provincial expenses for each expense accumulated from the cost of production studies, is typically higher than the provincial agricultural cost apportioned to crop production. Operating expenses were proportioned back as per the above outlined procedure for separating crop revenues into regions. This process is repeated for each expense category.

Total crop revenue and expense patterns are then incorporated into the I-O model development process.

Task # 2: Livestock and Confined Livestock in the SASS Region

Livestock and poultry activities were proportioned into the SASS and non-SASS region based on Statistics Canada census livestock inventories within each municipal region. Inventories were further divided in the SASS region into irrigated and non-irrigated agriculture by utilizing special tabulations from Statistics Canada, which reported livestock inventories on farms with irrigation as compared to census farms that did not report irrigation. Total provincial livestock and poultry receipts per census statistics were then proportioned by region and irrigation vs. non-irrigation by census inventory counts.

In order to estimate livestock related expenses, livestock inventories are adjusted to reflect total annual livestock production numbers. These included adjustments for feedlots in the southern region, that turn over 1.76 head for every animal reported in the early summer census. Similarly, the hog operations also have two plus farrowings in a year and thus total head sold is approximately 4 head per census inventories. Poultry flocks are also turned over several times through the year.

Livestock expenses were estimated from estimated livestock inventories (i.e., cow numbers) and from the number marketed (i.e., feeders) for all livestock and poultry activities. These estimated expenses were accumulated across the various municipal regions and irrigation areas, and compared to the provincial livestock related expenses as estimated in Step #1. The accumulated expenses were typically higher than the provincial census totals and individual expense items were proportioned back to reflect provincial totals. Expenses were then accumulated across municipal regions to generate SASS region expense patterns for irrigated and non-irrigated farms. This process was repeated for each individual expense category.

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7 Alberta Agriculture Food and Rural Development, 2003.

Livestock activities typical of confined livestock operations (CFO) are identified and reported as a separate CFO agricultural activity. Livestock operations identified as CFO included feeder cattle, dairy, hog, and poultry production.

3.4.2 Disaggregation of the Manufacturing Sector

The manufacturing sector of the model was also treated as a single economic sector in the Statistics Canada's transactions table. In order to identify the impact of various types of food processing, as well as refining of petroleum products, manufacturing was disaggregated into four sub-sectors: 1)The livestock slaughtering and meat processing, 2) and the petroleum refineries were separated out as single sectors. 3) The other food processing sectors consisted of other foods processors group except meat and meat products. 4) The remaining manufacturing industries were grouped as other manufacturing.
Use of various commodities in the production process for the manufacturing, refineries and other food processing sectors were obtained from the Alberta Bureau of Statistics. The data were provided in a coefficient form. To estimate the total value of transactions, these coefficients were multiplied by the estimated total output for the SASS and non-SASS region. The other manufacturing sector was simply the remaining expenditures by the manufacturing industries that are not claimed by the previous three sectors.

3.4.3 Disaggregation of Mining Sector

This sector was further sub-divided into two sub-sectors: Crude petroleum production and natural gas exploration, and Other mining sector. The coefficients for the crude petroleum production and natural gas were obtained from the Alberta Bureau of Statistics, which were in per unit of production basis. Total output of these sectors was estimated using estimated value of these products in Alberta. Division of this total between the SASS and non-SASS regions was done using employment data.

3.4.4 List of Study Sectors

The final list of sectors in the SASSIE is presented in Table 3.3. After disaggregating some of the original sectors, the final list included 28 sectors for this analysis. In this process, several sectors in the original Statistics Canada model were aggregated. These included: Other mining activities were added to the support services to mining and agriculture; Professional, scientific and technical services were added together with administrative and other support services. In addition, the information and cultural industries were renamed communications industries.

3.5 Estimation of SASS Region Value of Output

In order to put together the transactions table for the SASS region, it was imperative that the output of various sectors is known. This included particularly those where further disaggregation was done, as noted in the previous sections. Estimated level of output are shown in Table 3.4. The estimates were made in the following manner:

1. **Fishing:** These estimates were based on irrigation reservoir commercial fishing licenses.

2. **Logging:** Data on employment in the logging industry in various Census Division comprising the region was used as a proxy to divide the total provincial output into that within the SASS region and that outside. This implicitly assumes that labor productivity in all parts of the province is similar.

3. **Other Mining:** Similar to the logging sector, this estimate was also based on the employment data obtained from the Statistics Canada, using a similar methodology.

4. **Petroleum:** Regional production was based on the well count data and known output of known producing wells.

5. **Meat Slaughtering:** These estimates were based on the Alberta production, and annual reports of the SASS region major slaughtering plants (Lakeside and Cargill). Plants outside the SASS regions were also estimated, which then became the basis for the estimates.

Table 3.3: List of Sectors in the SASSIE Model

Sector No.	Sector Description
1	Dryland Agricultural Production
2	Irrigated Production
3	Confined Feeding Operations
4	Fishing, Hunting and Trapping
5	Forestry and Logging
6	Other Mining and Support Activities for Agriculture and Forestry
7	Crude Petroleum and Natural Gas
8	Livestock Slaughtering and Meat Processing
9	Other Food Processing
10	Petroleum Refining

Sector No.	Sector Description
11	Other Manufacturing
12	Construction
13	Transportation and warehousing
14	Communications Industry
15	Other Utilities
16	Wholesale Trade
17	Retail Trade
18	Finance, Insurance and Real Estate and Renting and Leasing
19	Professional, Scientific and Technical and Other Support Services
20	Educational Services
21	Health Care and Social Assistance
22	Accommodation and Food Services
23	Other Services (Including Arts, Entertainment and Recreation)
24	Operating, Office, Cafeteria and Laboratory Services
25	Travel and Entertainment, Advertisement and Promotion
26	Transportation Margins
27	Non-Profit Institutions Serving Households
28	Government Sector

Table 3.4: Level of Output of Selected Sectors in the SASS Region and for the Province of Alberta

Sector	SASS Region (,000$)	Province of Alberta (,000$)	SASS Region % of Province
Fishing	$960	$5,200	18.46
Logging	$730	$8,109	9.00
Other Mining	$25,503	$570,538	4.47
Crude Petroleum	$12,199,800	$35,671,929	34.20
Meat Slaughtering	$1,867,237	$2,044,246	91.34
Other Food Processing	$515,240	$982,533	52.44

Sector	SASS Region (,000$)	Province of Alberta (,000$)	SASS Region % of Province
Refineries	$266,792	$627,745	42.50
Other Manufacturing	$8,790,264	$16,733,798	52.53
Construction	$449,910	$900,000	49.99
Transportation	$2,989,350	$6,300,000	47.45
Other Utilities	$110,458	$203,646	54.24

6. **Other Food Processing:** Data were obtained from the Statistics Canada on labor force employed in these sectors by census division. Identical labor productivity was assumed to derive the regional production estimates.

7. **Refineries:** Regional refinery production was based on the number of plants in the region.

8. **Other Manufacturing:** Data were obtained from the Statistics Canada on labor force employed in these sectors by census division. Identical labor productivity was assumed to derive the regional production estimates.

9. **Construction:** This estimate was based on data obtained from Statistics Canada on building start and permit information, and from Government of Alberta, Ministry of Economic Development. These data pertained to major metropolitan cities (Edmonton, Calgary, Lethbridge, Red Deer, and Medicine Hat)

10. **Transportation:** Data were obtained from the Statistics Canada on labor force employed in these sectors by census division. Identical labor productivity was assumed to derive the regional production estimates.

11. **Other Utilities:** Data were obtained from the Statistics Canada on labor force employed in these sectors by census division. Identical labor productivity was assumed to derive the regional production estimates.

These output levels were used to develop the transactions table for the SASS region, employing technical coefficients that were derived using the approach described in the next section.

3.6 Estimation of the Regional Coefficients

In order to estimate the economic impacts of changing primary production level, it was imperative

that a model to be developed should be appropriate for economic impact analysis for the SASS region. Two approaches to regional modelling are commonly suggested: One, Survey method, in which primary data are collected from the regional firms and industries and a transactions table for the region is prepared. This option was not exercised since it is data intensive and with high resource requirements.

The second method is called a non-survey method. Here estimation of the regional coefficients is based on non-survey methods. Commonly used non-survey methods include: Location-Quotient Procedure; Cross-Industry Quotient Procedure; and, Supply-Demand Pool Technique. A location quotient compares the employment in a given industry as a measure of its self-sufficiency. More details on this method are provided below. A related approach is the cross-industry quotient procedure uses information about the selling industry as well as the purchasing industry. In the supply-demand pool, regional commodity balance is estimated to determine whether a region is self-sufficient or dependent on other parts of the larger region.
In this study the method of location quotients (LQ) was used to regionalize the Alberta transactions table. A LQ compares the region's allocation of resources in a given sector to that of the larger region for the same sector. If the region has a higher share of a certain industry, relative to the larger region, the region is deduced to be not only self-sufficient but even an exporter. If on the contrary, the region has difficulty in meeting its own needs, it becomes an importing region. Let X_{iR} and X_R represent gross output of the i^{th} sector and total output, respectively, in the SASS region, and similarly, X_{iP} and X_P denote these totals for the province of Alberta. Then the simple location quotient (LQ) for the i^{th} sector in Region R is defined as:

$$LQ_{iR} = \frac{X_{iR} / X_R}{X_{iP} / X_P} \qquad (3.1)$$

If the value of the LQ for the SASS region for a given sector is greater than one, it means that the sector in the SASS region is self-sufficient. The technology of production of this sector in the SASS region is then equated to the provincial technology. If, on the other hand, the value of LQ for an industry (sector) in the SASS region is less than one, the SASS region must obtain its requirements from outside the region – i.e., from other parts of the province. The per unit requirements are then estimated as shown in equations (3.2) and (3.3).

$$a_{ij}^r = a_{ij}^p \times LQ_i^r \qquad \text{If LQ} < 1 \qquad (3.2)$$

$$a_{ij}^r = a_{ij}^p \qquad \text{If LQ} > \text{or} = 1 \qquad (3.3)$$

Where, a_{ij}^r = SASS region's per unit requirements for the i^{th} commodity for the j^{th} sector;

LQ_i^r = Location quotient for the region for the i^{th} sector;

a_{ij}^p = Provincial per unit requirements for the i^{th} commodity for the j^{th} sector;

According to equation (3.2) if the region's LQ for industry *i* is less than one, the per unit requirements for that sector are adjusted by the LQ value. The shortfall in the local production is then assumed to be met by imports from other regions. If the LQ is one or greater than one, it is set equal to one, and the provincial technological coefficients are used.

Location quotients for each of the 28 study sectors were estimated using employment data for the region and for the province. Results are shown in Table 3.5. For most sectors, the SASS region is self-sufficient. However, in the production of forestry, fishing and trapping products, it is not the case. The government sector is also somewhat more dependent on the rest of the province for services required for the final production of various goods and services.

3.7 Preparation of the Final Table

The preparation of the final table required a number of steps starting with obtaining of the Statistics Canada base transactions table for the province. These steps are listed in this section.

1. Provincial input use, output and final demand tables were first checked for any missing values, caused by the confidentiality rule followed for these tables. Where such values were found missing, these were inserted by using row sum and column sum. Where such a procedure did not result in an identical match, a column of 'residual' was created. This was treated as a separate activity, but not included in the impact analysis.

2. Inter-provincial trade table for major commodities produced in the province was obtained from Statistics Canada. These transactions were used to create input requirements in the province that was met from inter-provincial and international trade. International trade was treated as a separate commodity. Similarly each of the Canadian regions trading with Alberta were retained as a separate source, and were treated as a separate good.

Table 3.5: Location Quotients for the SASS Region, by Sectors

Sector No.	Sector Description	Value of LQ
1	Dryland Agricultural Production	1.0000
2	Irrigated Production	1.0000
3	Confined Feeding Operations	1.0000
4	Fishing, Hunting and Trapping	0.8027
5	Forestry and Logging	0.2769
6	Other Mining and Support Activities for Agriculture & Forestry	0.9931
7	Crude Petroleum and Natural Gas	1.0000
8	Livestock Slaughtering and Meat Processing	1.0000
9	Other Food Processing	1.0000
10	Petroleum Refining	1.0000
11	Other Manufacturing	1.0000
12	Construction	0.9750
13	Transportation and warehousing	1.0000
14	Communications Industry	1.0000
15	Other Utilities	1.0000
16	Wholesale Trade	0.9716
17	Retail Trade	0.9716
18	Finance, Insurance and Real Estate and Renting and Leasing	1.0000
19	Professional, Scientific and Technical and Other Support Services	1.0000
20	Educational Services	0.9326
21	Health Care and Social Assistance	0.9348
22	Accommodation and Food Services	1.0000
23	Other Services (Including Arts, Entertainment and Recreation)	1.0000
24	Operating, Office, Cafeteria and Laboratory Services	1.0000
25	Travel and Entertainment, Advertisement and Promotion	1.0000
26	Transportation Margins	1.0000
27	Non-Profit Institutions Serving Households	1.0000
28	Government Sector	0.826

3. Using the location quotients for various sectors, regional input-output coefficients were created, as explained earlier.

4. The SASS transactions table was balanced and converted into a square format for impact analysis.

5. Mathematical routines were developed to undertake impact analysis. These programs were linked together to develop the 'Impact Analyzer', which is described in Chapter 4.

6. In order to undertake economic impact analysis, two pieces of information were required: Assumption of propensity to consume, and share of producers to the total money spent by consumer (final demand agencies) called Margins. These are described further in the following sub-sections.

3.7.1 Estimation of Propensity to Spend

In order to endogenize the households in the SASSIE model, it was necessary to obtain an estimate of propensity to consume. Not all income earned from the goods producing sectors are spent in the economy. This is because a portion of the incomes (including profits from the unincorporated farm and non-farm businesses) are taken away in the form of direct federal and provincial taxes. The compensating factor is the transfer payments received from the governments and the interest and dividend income transferred from the incorporated businesses. This required an estimation of a propensity to consume for the model.

Propensity to consume can be either a marginal propensity or an average propensity. The average propensity is simply the amount of consumer expenditures over a period of time that are spent on consumer goods and services. A marginal propensity is the proportion of the increased income that would be spent on consumer goods and services.

In this study, the marginal propensity to consume was estimated using data for the 1991 to 2000 period. These data were collected from Statistics Canada Government Accounts on total personal disposable income and personal consumer expenditures. The sample data were used to regress personal income against the personal expenditures. The result and estimate of propensity to consume was .99%. This situation can not be sustained in the long run.

As an alternative, average propensity to consume was estimated based on 1996 to 2000 data. The average propensity to consume was estimated to be 0.916. This estimate was also considered to be high and was reduced to 0.875 based on the experience during the early nineties in Alberta.

3.7.2 Margins for Various Commodities

When consumers or business concerns purchase a commodity, they are paying for various services associated with it along with the payment to producers. The difference between the purchaser's prices and producer's prices is called margins. There are seven margins that are generated by the purchase of a commodity:

(1) Retail margin
(2) Wholesale margin
(3) Tax margin
(4) Transportation margin
(5) Pipeline margin
(6) Storage Margin, and
(7) Gas margin

Each of these margins are collected by the sectors that provide the service. The retail margins are allocated to the Retail Trade sector; similarly the wholesale margin is allocated to the Wholesale Trade sector. These margins for various commodities are shown in Table 3.6.

3.7.3 Development of the Employment Module

Since the interest of this study was to estimate both economic activity related impacts as well as employment impacts of selected irrigation scenarios, an employment module was added to the input-output model as described above. The employment module contained the employment coefficient based on Leontieff employment function. It was a ratio of employment in that sector divided by the total sales (output) of that sector. These coefficients are presented in Table 3.7. In some sectors, detailed data were not available. This resulted in a similar coefficients. Case in point being the mining sectors and the petroleum and natural gas sectors.

Table 3.6: Margins for Various Commodities for Alberta, 1999

Commodities	Margins							Producer's Share of Purchasers Prices
	Retail	Wholesale	Tax	Transport	Pipeline	Storage	Gas	
1 Grains	0.00	0.08	0.00	0.09	0.00	0.05	0.00	0.78
2 Livestock and Poultry	0.03	0.03	0.00	0.02	0.00	0.00	0.00	0.92
3 Other agricultural products	0.03	0.03	0.00	0.02	0.00	0.00	0.00	0.92
4 Forestry products	0.00	0.01	0.00	0.11	0.00	0.00	0.00	0.88
5 Fish, seafood and trapping products	0.33	0.22	0.00	0.08	0.00	0.00	0.00	0.36
6 Metal ores & concentrates	0.00	0.00	0.08	0.20	0.00	0.00	0.00	0.72
7 Mineral fuels	0.00	0.00	0.00	0.01	0.10	0.00	0.02	0.87
8 Non-metallic minerals	0.01	0.03	0.00	0.54	0.00	0.00	0.00	0.43
9 Services incidental to mining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
10 Meat products	0.07	0.05	0.00	0.02	0.00	0.00	0.00	0.87
11 Fish and Dairy Products	0.07	0.05	0.00	0.02	0.00	0.00	0.00	0.87
12 Fruit, veg. and other food products, feeds	0.18	0.11	0.02	0.05	0.00	0.00	0.00	0.64
13 Soft drinks and alcoholic beverages	0.07	0.02	0.30	0.01	0.00	0.00	0.00	0.61
14 Tobacco and tobacco products	0.12	0.03	0.85	0.00	0.00	0.00	0.00	0.00
15 Leather, rubber, and plastic products	0.19	0.16	0.04	0.04	0.00	0.00	0.00	0.58
16 Textile products	0.24	0.19	0.05	0.02	0.00	0.00	0.00	0.50
17 Hosiery, clothing and accessories	0.62	0.11	0.11	0.01	0.00	0.00	0.00	0.15
18 Lumber and wood products	0.00	0.14	0.00	0.08	0.00	0.00	0.00	0.78
19 Furniture and fixtures	0.19	0.09	0.04	0.05	0.00	0.00	0.00	0.64
20 Wood pulp, paper and paper products	0.04	0.10	0.01	0.08	0.00	0.00	0.00	0.77
21 Printing and publishing	0.07	0.11	0.04	0.01	0.00	0.00	0.00	0.77
22 Primary metal products	0.00	0.13	0.00	0.09	0.00	0.00	0.00	0.79
23 Other metal products	0.03	0.21	0.01	0.03	0.00	0.00	0.00	0.72
24 Machinery and equipment	0.01	0.31	0.01	0.03	0.00	0.00	0.00	0.64
25 Motor veh., oth. transport equip. and parts	0.28	0.29	0.09	0.02	0.00	0.00	0.00	0.32
26 Electrical, electronic and communic. prod.	0.12	0.19	0.03	0.02	0.00	0.00	0.00	0.64
27 Non-metallic mineral products	0.05	0.11	0.01	0.07	0.00	0.00	0.00	0.76
28 Petroleum and coal products	0.01	0.05	0.07	0.02	0.02	0.00	0.00	0.83
29 Chemicals, pharmaceuticals & chemical prod.	0.07	0.08	0.01	0.03	0.00	0.00	0.00	0.81

30 Other manufactured products	0.34	0.21	0.07	0.02	0.00	0.00	0.00	0.35
31 Residential construction	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.95
32 Non-residential construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
33 Repair construction	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
34 Transportation and storage	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
35 Communications services	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.92
36 Other utilities	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.98
37 Wholesaling margins	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
38 Retailing margins	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
39 Gross imputed rent	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
40 Other finance, insurance, and real estate services	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
41 Business and computer services	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
42 Private education services	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.99
43 Health and social services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
44 Accommodation services and meals	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.95
45 Other services	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.89
46 Transportation margins	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
47 Operating, office, cafeteria and lab. supplies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
48 Travel & entertainment, advertising & promotion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
49 Non-profit institutions serving households	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
50 Government sector services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
51 Non-competing imports	0.68	0.30	0.00	0.01	0.00	0.00	0.00	0.00
52 Unallocated imports and exports	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
53 Sales of other government services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Table 3.7: Employment Coefficient (No. of Workers per Thousand Dollars worth of Output) for the SASS Region, by Sectors

Sector	Empl. Coeff.
1 Agricultural and related services ind.	0.019961
2 Irrigated Agriculture	0.015474
3 Feedlots/Confined Livestock Operations	0.007259
4 Fishing and trapping industries	0.062712
5 Logging and forestry industries	0.008188
6 Mining, quarrying and oil well industries	0.012777
7 Petroleum & Natural Gas	0.012777
8 Meat Slaughtering	0.006661
9 Other Food Processing	0.004996
10 Refineries	0.002498
11 Other Manufacturing industries	0.003333
12 Construction industries	0.004594
13 Transportation and storage industries	0.007850
14 Communication and other utility ind.	0.006103
15 Other utilities	0.006103
16 Wholesale trade industries	0.008991
17 Retail trade industries	0.025355
18 Finance, insurance and real estate ind.	0.001952
19 Business service industries	0.012816
20 Educational service industries	0.499156
21 Health and social service ind.	0.060467
22 Accommodation and food services ind.	0.022244
23 Other service industries	0.022986
24 Operating, office, cafeteria and laboratory supplies	0.022986
25 Travel & entertainment, advertising & promotion	0.022986
26 Transportation margins	0.007850
27 Non-profit institutions serving households	0.022986
28 Government sector	0.003996

3 8 Types of Impacts Generated from the SASSIE Model

The SASSIE model has the capability of generating two types of economic impacts of an economic development activity:

(1) Type I economic impacts, which include direct changes plus indirect changes (through the sale of goods and services to the direct impact sector) in various sectors of the economy. In this model household income is exogenous and is not assumed to be spent within the economy.

(2) Type II economic impacts, which include direct, indirect and induced effects from the aforesaid economic activity. Here, the assumption is that the households earn wages and salaries (plus other sources of income) which is spent concurrently within the economy.

If one is interested in estimation of indirect and induced effects of an economic development activity separately, one follows the following procedure: To yield indirect impacts, deduct from Type I economic impacts estimated direct impacts. Similarly to obtain induced impacts, one deducts Type I impacts from the Type II impacts.

4 THE IMPACT ANALYSER PROGRAM

All the data described in the previous chapter were used to create a program that can simplify economic impact assessment for a given ALCES scenario. Development of this program is described in this chapter.

4.1 Development of the Impact Analyser Program

The following is the mathematical solver component of the I-O impact methodology for estimating the impacts of a given set of changes in the SASS regional economy. All values in the model are dollar values relative to the units used in the input matrix. The method of estimation of these impacts is described in Chapter 6.The Impact Analyser program is a set of programs (macros) designed to invert the coefficients matrix for use in the impact assessment. This required several steps, as described below:

1. From the "Input or Technology" matrix data, per unit requirements of various commodities were calculated. The resulting matrix was called "B-Mat". This matrix reflected producers prices, and did not require any adjustment for margins.

2. From the "Output/Make" matrix for the region, market shares of various sectors in the production of each commodity were estimated. These results were called "D-Mat".

3. From the B-Mat, the proportion of a commodity that was supplied from imports from other parts of Alberta, or form other parts of Canada or the world, were netted out.

4. Other leakage (including inventory adjustments, and government sales) were also netted out from various sector's requirements of various commodities. The resulting matrix, called "Adjusted B-Mat", was in producers prices and reflected local purchases of commodities.

5. The D-Mat was multiplied by the adjusted B-Mat to produce a sector by sector coefficient matrix reflecting technology of production for each sector.

6. The resulting matrix was used to generate an inverted matrix $[(I-DB)^{-1}]$. This matrix is the final demand multiplier matrix for each sector.

7. The primary input requirements for each sector along with the multiplier matrix in Step 6 were used to create impact of a change in final demand on various value-added items in the economy.

8. The employment coefficients along with the multiplier matrix were used to create an impact of a change in final demand on the employment of the sector.

4.2 Features of the SASSIE Model

The SASSIE model is capable of estimating the impacts of either change in the final demand for a product (change in consumer expenditures, government current expenditures, government investment expenditure, business expenditures, or exports) and /or change in the level of output of a sector. In addition, it has the following features:

1. Any sector that the analyst believes should not be affected in a given scenario can be exogenized. Once a sector is exogenized, its output is fixed at the pre-scenario level and does not undergo any further changes.

2. The program provides flexibility in the nature of direct impacts. At the present it has the following choices:

   (I) Final (or intermediate) demand in commodity format in purchaser's prices and total purchases (Local plus imports). The program will remove the imports from the scenario and convert the purchases into producer's prices.

   (ii) Final (or intermediate) demand in commodity format in purchaser's prices in local purchases only. The program in this case will remove the margins and convert the purchaser's prices into producer's prices.

(iii) Final (or intermediate) demand in commodity format in producer's prices and local purchases. The program will not remove either the imports from the scenario and or margins.

(iv) Final (or intermediate) demand in commodity format in producer's prices in total purchases. The program in this case will remove the imports.

3. The program is capable of estimating the Type I impacts (direct and indirect) and / or Type II impacts (direct, indirect and induces).

The actual mechanics of estimating these impacts is described in Chapter 6 of this report.

5 INTERFACE MODULE

The "Interface" module is the link that connects the output of the ALCES model to the SASSIE model. A key question concerning the integration of ALCES and economic models is whether there will be an automated linkage or a lengthy time step between a question and the modeled results (i.e., will table-top "gaming" be possible). The following key questions arise in this context:

- What is the change in the human landscape footprint under different economic scenarios? Analysis of landscape footprint may be considered at the regional or land-cover scale.

- What is the impact on the economy, and consequently the landscape footprint, under different resource management regimes?

The Interface algorithm was developed to estimate the economic implications of the changes in the ALCES model output. More details on this module are provided in this chapter.

5.1 Major Components of the Interface Module

The interface module has five main components:

(1) Convert physical values from the ALCES mode into dollar values (direct impacts) for crop production and non-agricultural production;

(2) Estimate the potential impacts of these physical activities on processing opportunities in the region such as slaughtering, food processing and oil refining. (forward linkages);

(3) Develop expenditure patterns for the direct impacts and forward linkages as estimated above;

(4) Adjust for imports and GDP impacts to compensate for declining industries in the region; and,

(5) Format the above information as an input file for the SASSIE model Impact Analyzer.

Each of these is described below

5.2 Conversion of ALCES Physical Output to Monetary Values

One of the primary purposes of the SASSIE model developed herein is to measure the financial impacts arising from changes in the physical landscape. Physical landscape issues of interest include levels of primary industry production and human demands for goods and services, which in turn often impact on or are dependent on the region's physical landscape. The impacts on the physical landscape are simulated and measured via the ALCES landscape simulator.

Output from this physical simulator to be used by the SASSIE model includes the following categories:

- Hydrocarbon Production (4 categories)
- Crop Production (5 categories)
- Livestock Sales (3 categories)
- Wood Harvest (2 categories)
- Tourism Activity Day (2 categories)
- Human Population (3 categories)
- Livestock Population (3 categories)
- Water Demand (4 categories)
- Wildlife Harvest (4 categories)

Each of these types of output were converted into monetary units commensurable with the SASSIE model. This procedure is described below.

5.2.1 Conversion of Crop Output

The ALCES model output is in physical units (such as tons of production) for five crop categories namely: cereals, oilseeds, legumes, forages, and tame pasture. The difference of the total tonnage of these five crop categories, from the total crop production in the region per the ALCES model output is categorized as "other" in the I-O model.

The SASSIE model requires inputs by dollar values for the aggregated total of non-irrigated and irrigated crops. Dollar values as input to the SASSIE model, requires the value of sales and the corresponding production expenditure patterns for irrigated and non-irrigated crops. Cost of crop production expenditure patterns and returns are available for individual crops by irrigated and non-irrigated crop status on a per acre basis from Alberta Agriculture publications. Conversion coefficients were developed for each of the representative crop types.

Development of the conversion coefficient required several steps:

One, Selection of a representative crop for each of the five crop categories plus the "other"category. These included:

Cereals – Barley
Oilseed – Canola
Legumes – Dry Beans
Forages – Alfalfa
Pasture – Pasture
Other – Potatoes

Two, Determine the proportion of irrigated and non-irrigated acres for each crop in the SASS region.

Three, Determine the typical or average tonnage produced per acre for irrigated and non-irrigated crop production.

Four, The initial coefficient for each crop is the inverse of the tonnage per acre.

Five, The total value of production for each crop type is estimated as the product of crop prices and ALCES production. The initial coefficient for each crop type is adjusted to reflect the relative value of production estimated in Task One above. Crop prices are shown in Table 5.1.

Six, This derived coefficient is used as the conversion coefficient in the crop worksheet of the ALCES I-O interface model.

The end result of these steps was a value that could be used for impact analysis purpose.

Table 5.1: Crop- Product Prices Used for Conversion of ALCES Output (year 2001)

Particulars	Unit of Price	Price per Unit
Cereal	$ per Tonne	$142.00
Oilseed	$ per Tonne	$239.00
Legume	$ per Tonne	$563.00
Forage	$ per Tonne	$120.00
Tame pasture	$ per Tonne	$ 60.00
Potatoes [1]	$ per Tonne	$136.00

5.2.2 Conversion of Non-Crop Products Output

The following dollar values for the year 2001 were derived for the ALCES physical outputs. These are listed in Table 5.2. These prices were the prevailing market prices for these products. This valuation thus provides the monetary value of the ALCES production in the SASS region.

The nature of the products included here are various types of hydrocarbons, livestock production from agriculture industry, forest industry, and tourism. Since some commodities, such as cattle and hogs consist of several individual products, a weighted average price was required, and thus, calculated using available data.

1. This price for potatoes is academic as the potato is used as a surrogate for all other high and low valued crops. The price per tonne is modified in the Interface Model to balance the total value of other crop production to the value of ALCES production.

Table 5.2: Details on the Valuation of Non-Crop Product Output (year 2001)

ALCES Product	Commodity	Unit of Price	Price per Unit
Hydrocarbon	Conventional Oil	$ per Cubic meter	$40.57
	Natural Gas	$ per Cubic meter	$ 0.189
	Coal-bed Methane	$ per Cubic meter	$ 0.189
	Coal	$ per tonne	$15.00
Cattle Activities	Includes weighted average of cow calf, feedlot, culls, and dairy returns for total cattle inventory	$ per head	$720.00
Swine Activities	Includes costs of all breeding stock, all market hogs and culls for total hog inventory	$ per head	$165.00
Horse Activities	Includes dollars spent on all horse activities based on total horse inventory	$ per head	$1,500.00
Wood Harvest	Softwood	$ per m^3	$212.00
	Hardwood	$ per m^3	$212.00
Tourist Activity Days	Local	$ per day	$ 46.51
	Out of Province	$ per day	$ 63.26

5.3 Estimation of Forward Linkages of ALCES Output

Many of the products listed in Table 5.1 and 5.2 are further processes – a concept known as the forward linkages are established by the production of these commodities. Included here are refining of petroleum products for local production, slaughtering of cattle and hogs into meat and meat products, and processing of other foods in the region. The conversion factors used for these linkages were: (1) Petroleum Refining estimated at $ 0.46 per dollar of petroleum production; (2) Meat Slaughtering estimated at $933.00 per Animal Unit of cattle and swine sold; and (3) Other Food Processing estimated at $ 0.55 per dollar of crop sales.

5.4 Estimation of Expenditure patterns for the Direct and Forward Linkage Based Change

The production of various commodities by the ALCES model, as converted into monetary values along with their associated forward linkages (change in the level of processing brought about the change in production), were used to determine the nature of expenditures on various commodities in the SASS region.

Most of these details were obtained either from external sources (such as cost of production budgets for various crops) or using the per unit requirements for various sectors.

5.5 Adjustment for Imports and Other Impacts

Direct expenditures require adjustments in the purchases for imports vs. local purchases. These adjustments were made using the self-supply ratio for each commodity in the SASSIE model.

5.6 Formatting for the SASSIE Model Impact Analyser.

The final stage in the preparation of the Interface module was arranging all the above information and converting them into per unit requirements for each of the ALCES and forward linked sectors. This led to the data presented in Table 5.3. For future scenario analysis, these values need to be multiplied by the level of new output (or a change from the base output) for these commodities. The SASSIE model can then be used for estimating the total economic impacts on the SASS region.

5.7 Structure of the Interface Module

The Interface module consists of 12 worksheets, each designed for a specific task. These tasks are described in this section.

1. **ALCES:** This worksheet is a direct copy of the ALCES model output. This copy is possible since the ALCES model output is provided in an Excel format. This worksheet contains physical outputs for various simulations (year 0 to Year 50).

2. **Year:** This worksheet is a direct copy of the year for which economic impact analysis is to be undertaken. This information is manually copied from the ALCES worksheet to this worksheet. Proper placing of the pasted cell is critical for proper functioning of the Interface module. The model runs automatically, except for the balancing requirements in the initial year.

3. **Hydrocarbon:** This worksheet automatically copies physical values from the "Year" worksheet. These data are then multiplied by the values (as presented in Table 5.2) for these products. The value of production is balanced (in Year 0) to the level of output in the SASSIE model. Industry cost of production data are used for deriving purchased materials, salaries and other expenditures.

4. **Crop:** Crop production in this module is a sum of the five commodities produced by the ALCES model. The physical values are copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Table 5.1, and then translated into detailed commodity expenditures using industry specific data.

Table 5.3: Expenditure Patterns for the ALCES Related Sectors

Commodities		Hogs	Cattle	Horse	Hard-wood	Soft-wood	Local TAD	O of P TAD	Slaug-hter	Other Food	Petr. Refiner.
1	Grains	0.485	0.101	0.053	0.000	0.000	0.000	0.000	0.000	0.199	0.000
2	Other agricultural products	0.055	0.653	0.160	0.000	0.000	0.000	0.000	0.840	0.403	0.000
3	Forestry products	0.000	0.000	0.000	0.190	0.190	0.000	0.000	0.000	0.000	0.000
4	Fish, seafood and trapping prods.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	Metal ores & concentrates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Mineral fuels	0.010	0.013	0.073	0.080	0.080	0.082	0.249	0.000	0.000	0.773
7	Non-metallic minerals	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	Services incidental to mining	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	Meat, fish, and dairy products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	Fruit, veg. and other food products, feeds	0.139	0.013	0.108	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Soft drinks and alcoholic beverages	0.000	0.000	0.018	0.000	0.000	0.135	0.091	0.000	0.000	0.000
12	Tobacco and tobacco products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	Leather, rubber, and plastic products	0.000	0.000	0.113	0.000	0.000	0.028	0.000	0.000	0.000	0.000
14	Textile products	0.000	0.000	0.000	0.000	0.000	0.028	0.000	0.000	0.000	0.000
15	Hosiery, clothing and accessories	0.000	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.000	0.000
16	Lumber and wood products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.001
17	Furniture and fixtures	0.000	0.000	0.000	0.000	0.000	0.028	0.000	0.000	0.000	0.000
18	Wood pulp, paper and paper products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	Printing and publishing	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000
20	Primary metal products	0.000	0.000	0.013	0.010	0.010	0.000	0.000	0.000	0.000	0.000
21	Other metal products	0.000	0.001	0.000	0.010	0.010	0.000	0.000	0.000	0.000	0.000
22	Machinery and equipment	0.003	0.007	0.000	0.100	0.100	0.000	0.000	0.002	0.002	0.001
23	Motor veh., oth. transport equip. and parts	0.015	0.012	0.147	0.080	0.080	0.079	0.241	0.000	0.000	0.000

24	Electrical, electronic and communic. prod.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.001
25	Non-metallic mineral products	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	Petroleum and coal products	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.007	0.003
27	Chemicals, pharmaceuticals & chemical prod.	0.010	0.018	0.027	0.030	0.030	0.000	0.000	0.000	0.000	0.000
28	Other manufactured products	0.000	0.000	0.033	0.050	0.050	0.000	0.000	0.004	0.004	0.002
29	Residential construction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	Non-residential construction	0.004	0.004	0.000	0.010	0.010	0.000	0.000	0.016	0.017	0.010
31	Repair construction	0.013	0.011	0.090	0.020	0.020	0.000	0.000	0.004	0.004	0.002
32	Transportation and storage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	Communications services	0.015	0.003	0.000	0.010	0.010	0.000	0.000	0.008	0.006	0.013
34	Other utilities	0.024	0.009	0.010	0.032	0.032	0.000	0.000	0.018	0.015	0.009
35	Wholesaling margins	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	Retailing margins	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	Gross imputed rent	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	Other finance, insurance, and real estate services	0.004	0.004	0.000	0.020	0.020	0.048	0.146	0.006	0.020	0.022
39	Business and computer services	0.008	0.003	0.080	0.080	0.080	0.000	0.000	0.003	0.005	0.029
40	Private education services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	Health and social services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	Accommodation services and meals	0.000	0.000	0.037	0.000	0.000	0.385	0.091	0.000	0.000	0.000
43	Other services	0.010	0.010	0.037	0.000	0.000	0.031	0.095	0.002	0.002	0.001
44	Transportation margins	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	Operating, office, cafeteria and lab. supplies	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	Travel & entertainment, advertising & promotion	0.000	0.001	0.000	0.000	0.000	0.100	0.085	0.003	0.003	0.004
47	Non-profit institutions serving households	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	Government sector services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	Non-competing imports	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

50	Unallocated imports and exports	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	Sales of other government services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	Indirect taxes	0.010	0.005	0.000	0.038	0.038	0.000	0.000	0.010	0.209	0.020
53	Subsidies	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	Wages and salaries	0.069	0.026	0.000	0.119	0.119	0.000	0.000	0.049	0.069	0.020
55	Supplementary labour income	0.011	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	Mixed income	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	Other operating surplus	0.114	0.061	0.000	0.122	0.122	0.000	0.000	0.031	0.033	0.089
58	TOTAL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

5. **Livestock:** Livestock production included cattle and hog enterprises. Poultry production is considered to remain proportional to the total value of livestock production. The number of cattle are proportioned into cow-calf, feedlot and dairy enterprises. Adjustments are also made to the cow-calf enterprises for total number of calves sold per beef cow, and to the dairy enterprises for non-lactating cows. The physical values are copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Table 5.2, and then translated into detailed commodity expenditures using industry specific data.

6. **Horse:** Horse population in the SASS regions is copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Table 5.2, and then translated into detailed commodity expenditures using industry specific data.

7. **Lumber:** Softwood and hardwood harvest volumes, as produced by the ALCES model, are copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Table 5.2, and then translated into detailed commodity expenditures using industry specific data.

8. **Tourism:** Nature of tourist activity – in terms of number of visitor-days – local and out of province, to the SASS region are copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Table 5.2, and then translated into detailed commodity expenditures using industry specific data. Data on the expenditures are obtained from Statistics Canada's Travel Survey information.

9. **Process:** This worksheet captures various forward linkages from the production in the previous six worksheets (Worksheets 3 to 8). The physical values are copied from the "Year" worksheet. These values are converted into monetary values using prices presented in Section 5.3, and then translated into detailed commodity expenditures using industry specific data.

10. **Summary:** This worksheet adds up all the commodity purchases from previous commodity production worksheets (Worksheets 3 to 9).

11. **Initial:** This worksheet is used to balance the ALCES physical output to the SASSIE model output. This worksheet is developed only for the initial year. Any simulation after that time period uses the same coefficients of adjustment.

12. **GDP adj:** This worksheet is designed to make adjustments in the output and GDP of the SASS region triggered by falling production of some hydrocarbon products.

6 INTRODUCTION TO IMPACT ANALYSIS

Economic impacts of a change in the SASS regions's economic activity related to a specific project or a change can be estimated using the SASSIE model. Impacts can be estimated in a variety of ways. Two of these are more commonly used. The simplest form of impact analysis is called the Multiplier analysis. However, a standard economic impact analysis is a little more complicated than this. Both of these are described in this chapter.

6.1 Multiplier Analysis

Multipliers provide a tool whereby the total impact of a change in a given production activity (sector) can be estimated on the economy. Total economic impacts on the output (sales) of a sector can be derived as follows:

Change in Total Sales of all Sectors	=	Multiplier for j^{th} Sector	*	Change in Final Demand For the j^{th} Sector	(6..1)

Type I and Type II multipliers for the SASS region are shown in Table 6.1. Thus, change in the final demand for the agriculture (dryland) and related industries is estimated to have a Type I multiplier of 1.838 and a Type II multiplier of 2.215. Thus, for every dollar worth of final demand change, there is an indirect impact of $0.84 (Difference between Type I multiplier and One dollar); and an induced impact of $0.38 (Difference between Type II and Type I multipliers). Thus, if the demand (exports) for the agricultural products increased by $1 million, other industries will increase their output by $838 thousands, and another $377 thousand will be added through the spending and re-spending of the income earned by workers engaged in the production of various goods and services in the region. Using information on the per unit contribution made by each sector, these multipliers can also be estimated for the various primary inputs – labour income, gross domestic product, imports, as well as for employment.

6.2 Standard Economic Impact Analysis

The Impact Analyser program as described in Chapter 4 is designed for standard economic impact assessments. The basic logic of this analysis is very similar to that of the Multiplier analysis. The total change is related to the multiplier matrices contained within the program through various operations (as programmed in various macros specially written for this purpose).

Details on the process of impact estimation are shown in Figures 6 and 7. In Figure 6, creation of the Impact Analyser program is illustrated, whereas Figure 7 shown details set of steps involved in the estimation of economic impacts.

Table 6.1: List of Values of Final Demand Multipliers for Various Economic Sectors in the SASS Region (1999)

Economic Sector	Type I	Type II
1 Agricultural and related services ind.	1.838	2.215
2 Irrigated Agriculture	1.827	2.288
3 Feedlots/Confined Livestock Operations	2.623	3.282
4 Fishing and trapping industries	1.448	2.808
5 Logging and forestry industries	1.961	2.785
6 Mining, quarrying and oil well industries	1.298	1.796
7 Petroleum & Natural Gas	1.614	2.053
8 Meat Slaughtering	3.016	3.687
9 Other Food Processing	2.483	3.031
10 Refineries	2.468	3.022
11 Other Manufacturing industries	1.842	2.407
12 Construction industries	1.750	2.602
13 Transportation and storage industries	1.650	2.528
14 Communication and other utility ind.	1.537	2.315
15 Other utilities	1.412	1.761
16 Wholesale trade industries	1.606	2.560
17 Retail trade industries	1.600	2.704
18 Finance, insurance and real estate ind.	1.489	2.220
19 Business service industries	1.587	2.750
20 Educational service industries	1.419	2.819
21 Health and social service ind.	1.409	2.520
22 Accommodation and food services ind.	1.929	2.876
23 Other service industries	1.491	2.607
24 Operating, office, cafeteria and laboratory supplies	1.793	2.139
25 Travel & entertainment, advertising & promotion	2.473	3.252
26 Transportation margins	2.522	3.346
27 Non-profit institutions serving households	1.489	2.773
28 Government sector	1.601	2.751

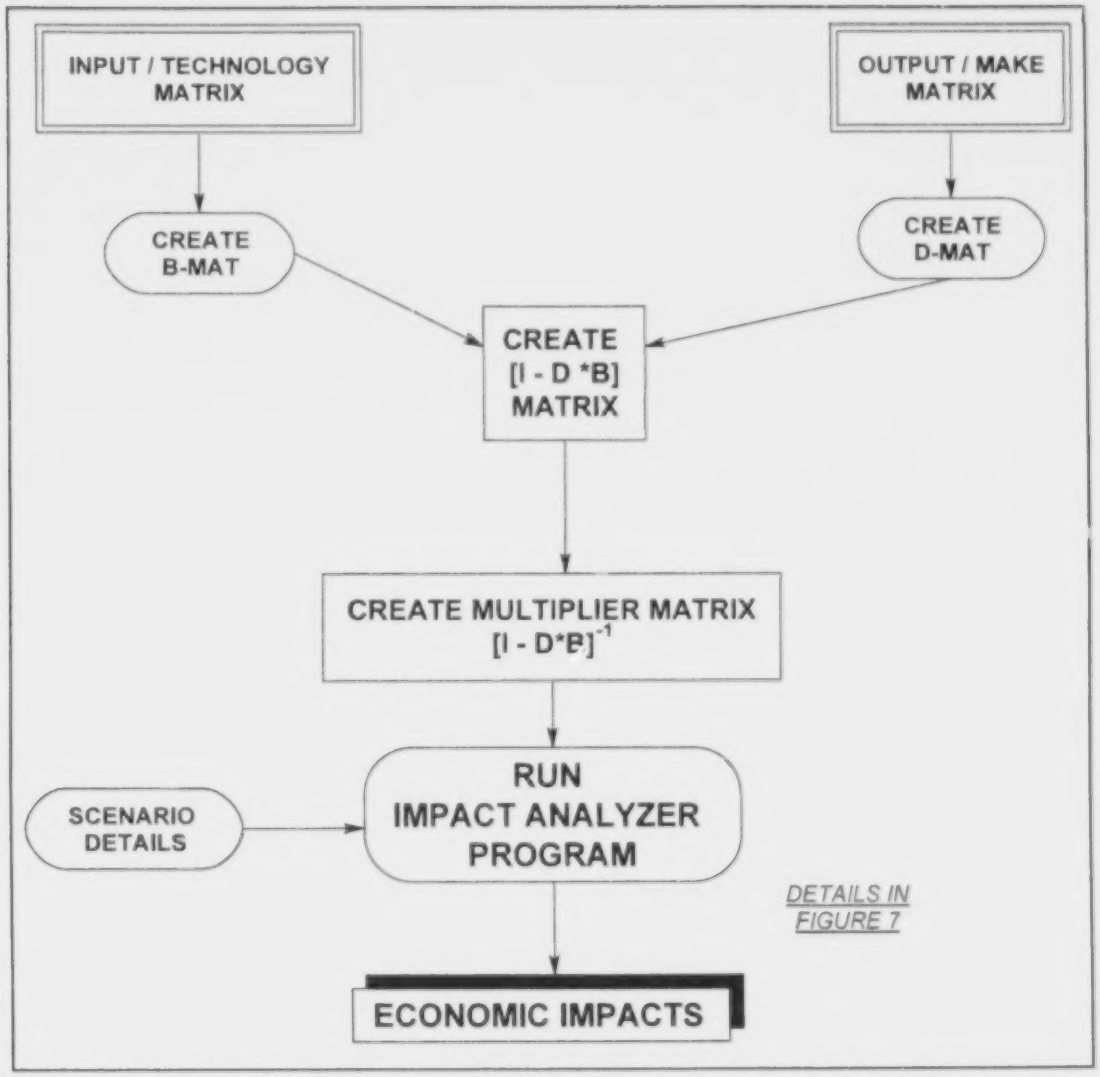

Figure 7: Overview of Economic Impact Analysis

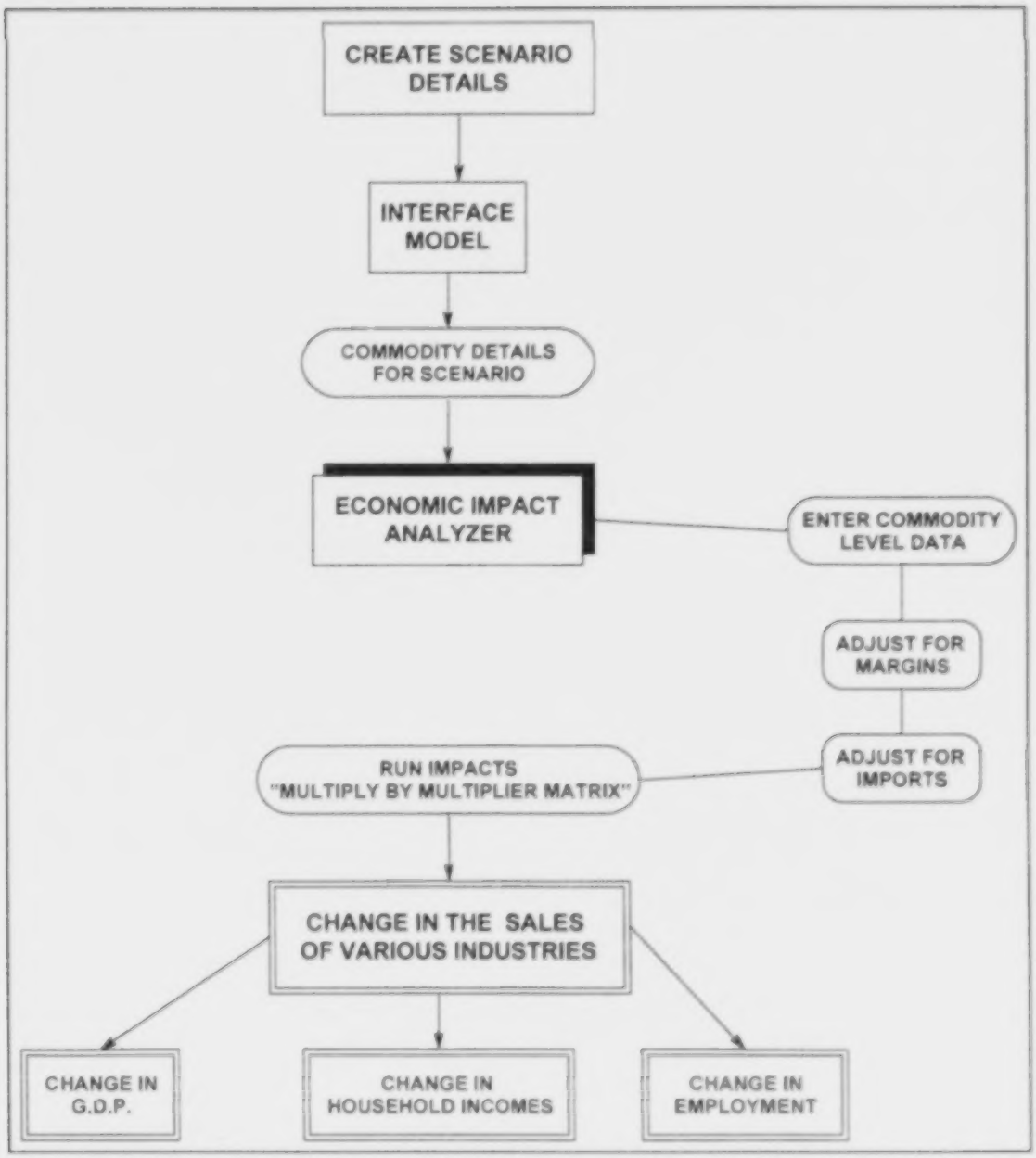

Figure 8: Details Procedure for Scenario Analysis for Economic Impact Estimation

Economic impacts are based on the coefficients that are derived from the two basic matrices noted in Chapter 2 – Input or technology matrix, and Output or make matrix. Each of these values are converted into per unit coefficients. The coefficients in the Input matrix are divided by the total sales of the sector. This results in the creation of B-Mat, which shows the requirements of various inputs to produce one unit of output for a sector. The values in the Output matrix are divided by the respective total production of a given commodity. This results in the creation of a matrix called D-Mat. This matrix shows the share of each industry in the production of a given commodity. These two matrices (B-Mat and the D-Mat) are used to create the multiplier matrix that is used for the impact estimation.

In order to run a scenario, as shown in Figure 7, details on a project are needed. These details pertain to the manner in which money would flow into the economy. These details are worked in a commodity space – i.e., in terms of amount for various commodities (as listed in Table 3.2). Details on these scenario, as noted earlier, are based on the ALCES model. These values undergo some transformation through the Interface Model to provide information of the initial economic impact under that scenario. Total economic impacts of the scenario are provided by the Economic Impact Analyzer program, which requires a number of steps – adjustment for margins, adjustments for imports, converting the commodity space to sectoral space, and then multiplying these values by the respective values in the multiplier matrix. Result of these operations is the estimated output for various sectors in the region. From these values, one can create impacts on other economic indicators – GDP, Household Income, Employment.

To demonstrate the procedure to be followed in undertaking economic impact assessment, a hypothetical example of a change in livestock products's exports by a million dollars is assumed. To undertake this assessment, the following steps are required:

Step 1: Click open the program "Screen-AB99.xls".

Step 2: Enable macro, when the window giving this option is opened by the program.

Step 3: The new page will appear with the title "Impact Analyzer Scenario Builder". This is the main body of providing inputs into the program and the assumptions that are made with respect to the nature of data. This worksheet requires seven sub-steps.

Sub-step 3.1: Choose the region of impact. Three choices are available: (1) AB99-Prov (Province of Alberta); (2) AB((-SARS (SASS Region); and (3) AB99-RestofProv (Rest of Alberta region).

For the present scenario, the 'AB99-SARS' region was selected. In other words, the analysis is undertaken for the impact on the SASS regional economy.

Sub-step 3.2: Enter data. In this step enter all the changes for various

commodities final demand and/or purchases. Each and every commodity plus the direct employment in the sector are included under this sub-step.

For the hypothetical scenario, a value of $1,000 (since the model is in thousand dollars ($1,000 in the model means $1 million).

Sub-Step 3.3: If the data in Sub-Step 3.2 are in purchasers prices, in this step various margins are removed. Clip the box asking you to remove the margins, if such is the case.

If the data in Sub-step 3.2 are in producers' prices, skip this action.

Sub-step 3.4: If the data are in total purchases (local plus imports), use this step to net out the imports of various goods and services included in the direct change vector in sub-step 3.2. Clip the box asking you to remove the imports, if such is the case.

If the data in Sub-step 3.2 are in terms of local purchases, skip this action.

Results for the hypothetical scenario are shown in Table 6.2. The first column contains the commodities as entered into the program under sub-step 3.2. The initial demand (sub-step 3.2 is in the second column). The third column is generated after margins are removed, whereas the fourth column is created after removing the imports from column two.

Sub-step 3.5: Create industry vector. This equivalent to multiplying the commodity demand by the D-Mat (as estimated earlier). The resulting demand is now converted into demand for various economic sectors. The resulting matrix is shown in Table 6.3.

Sub-step 3.6: Exogenize a sector, if necessary. If you believe that the output of a given sector should not change, use this option to exogenize it.

Sub-step 3.7: Run impacts. Click this switch and the impacts are estimated for the scenario and the results are written on a file called "Results Template.xlt".

Table 6.2: Nature of Initial (Direct) Demand Vector after Several Adjustments

Commodity	*Initial* Demand Vector	*Initial* & Margins Removed	*Margins* & Imports Removed
1 Grains	0.0	0.0	0.0
2 Livestock and Poultry	1000.0	918.1	857.2
3 Other agricultural products	0.0	0.0	0.0
4 Forestry products	0.0	0.0	0.0
5 Fish, seafood and trapping products	0.0	0.0	0.0
6 Metal ores & concentrates	0.0	0.0	0.0
7 Mineral fuels	0.0	0.0	0.0
8 Non-metallic minerals	0.0	0.0	0.0
9 Services incidental to mining	0.0	0.0	0.0
10 Meat products	0.0	0.0	0.0
11 Fish and Dairy Products	0.0	0.0	0.0
12 Fruit, veg. and other food products, feeds	0.0	0.0	0.0
13 Soft drinks and alcoholic beverages	0.0	0.0	0.0
14 Tobacco and tobacco products	0.0	0.0	0.0
15 Leather, rubber, and plastic products	0.0	0.0	0.0
16 Textile products	0.0	0.0	0.0
17 Hosiery, clothing and accessories	0.0	0.0	0.0
18 Lumber and wood products	0.0	0.0	0.0
19 Furniture and fixtures	0.0	0.0	0.0
20 Wood pulp, paper and paper products	0.0	0.0	0.0
21 Printing and publishing	0.0	0.0	0.0
22 Primary metal products	0.0	0.0	0.0
23 Other metal products	0.0	0.0	0.0
24 Machinery and equipment	0.0	0.0	0.0
25 Motor veh., oth. transport equip. and parts	0.0	0.0	0.0
26 Electrical, electronic and communic. prod.	0.0	0.0	0.0
27 Non-metallic mineral products	0.0	0.0	0.0
28 Petroleum and coal products	0.0	0.0	0.0
29 Chemicals, pharmaceuticals & chemical prod.	0.0	0.0	0.0
30 Other manufactured products	0.0	0.0	0.0
31 Residential construction	0.0	0.0	0.0
32 Non-residential construction	0.0	0.0	0.0
33 Repair construction	0.0	0.0	0.0
34 Transportation and storage	0.0	3.7	3.4
35 Communications services	0.0	0.0	0.0
36 Other utilities	0.0	0.0	0.0
37 Wholesaling margins	0.0	31.2	31.1
38 Retailing margins	0.0	26.1	26.1
39 Gross imputed rent	0.0	0.0	0.0
40 Other finance, insurance, and real estate services	0.0	0.0	0.0
41 Business and computer services	0.0	0.0	0.0
42 Private education services	0.0	0.0	0.0
43 Health and social services	0.0	0.0	0.0
44 Accommodation services and meals	0.0	0.0	0.0
45 Other services	0.0	0.0	0.0

Commodity	Initial Demand Vector	Initial & Margins Removed	Margins & Imports Removed
46 Transportation margins	0.0	18.6	18.6
47 Operating, office, cafeteria and lab. supplies	0.0	0.0	0.0
48 Travel & entertainment, advertising & promotion	0.0	0.0	0.0
49 Non-profit institutions serving households	0.0	0.0	0.0
50 Government sector services	0.0	0.0	0.0
51 Non-competing imports	0.0	0.0	0.0
52 Unallocated imports and exports	0.0	0.0	0.0
53 Sales of other government services	0.0	0.0	0.0
54 Indirect taxes	0.0	2.2	2.2
55 Subsidies	0.0	0.0	0.0
56 Labour Income	0.0	0.0	0.0
57 Other operating surplus	0.0	0.0	0.0
58 Imports NFLD	0.0	0.0	0.0
59 Imports PEI	0.0	0.0	0.0
60 Imports NS	0.0	0.0	0.0
61 Imports NB	0.0	0.0	0.0
62 Imports QU	0.0	0.0	0.0
63 Imports ON	0.0	0.0	0.3
64 Imports MN	0.0	0.0	8.6
65 Imports SK	0.0	0.0	24.6
66 Imports AB	0.0	0.0	0.0
67 Imports BC	0.0	0.0	16.2
68 Imports Terr	0.0	0.0	0.1
69 Imports Foreign	0.0	0.0	11.4
70 Other Leakages	0.0	0.0	0.0
71 Total Employment	0	0	0
72 Total (not including employment)	1000	1000	1000

Step 4: Open the "Results Template.xlt". It contains six worksheet. The "Initial" worksheet contains the Table 6.2 and 6.3. The second worksheet "multipliers" contains the multipliers shown in Table 6.1. The next four worksheets are the results of impacts disaggregated by various sectors. These are described in the next section.

6.3 Interpretation of Results of Impact Analysis

The program write economic impacts by sector at two levels: One, at a more detailed level, and Two, at a small level of disaggregation. The magnitude of impacts is identical in all these table; simply the items are added together more in the summary tables. Both the detailed results and summary results are printed for Type I and Type II impacts. The 'Output' is presented in the same manner. The Gross Domestic Product at factor costs is a sum of labour income and operating surplus.

If to this figure, one adds the Indirect taxes and deducts the subsidies, one arrives at the GDP at market prices. Imports in the summary table are a sum of all inter-provincial (from Newfoundland to British Columbia plus other Canada) and foreign imports, along with other leakage. Employment in both the sets of tables remains unchanged.

For the hypothetical scenario, summary of the results for Type I impacts are presented in Table 6.4, whereas the Type I impacts in Table 6.5.

Table 6.3: Composition of the Initial Final Demand by Sectors

Sectors	Initial Sectoral Demand
1 Agricultural and related services ind.	139.1
2 Irrigated Agriculture	9.6
3 Feedlots/Confined Livestock Operations	708.5
4 Fishing and trapping industries	0.0
5 Logging and forestry industries	0.0
6 Mining, quarrying and oil well industries	0.0
7 Petroleum & Natural Gas	0.0
8 Meat Slaughtering	0.0
9 Other Food Processing	0.0
10 Refineries	0.0
11 Other Manufacturing industries	1.8
12 Construction industries	0.0
13 Transportation and storage industries	3.3
14 Communication and other utility ind.	0.5
15 Other utilities	0.3
16 Wholesale trade industries	29.1
17 Retail trade industries	24.0
18 Finance, insurance and real estate ind.	0.2
19 Business service industries	0.2
20 Educational service industries	0.0
21 Health and social service ind.	0.0
22 Accommodation and food services ind.	0.4
23 Other service industries	0.5
24 Operating, office, cafeteria and laboratory supplies	0.0
25 Travel & entertainment, advertising & promotion	0.0
26 Transportation margins	18.6
27 Non-profit institutions serving households	0.0
28 Government sector	0.1
29 Indirect Taxes	2.2
30 Subsidies	0.0
31 Labour Income	0.0
32 Oth. Oper. Surplus	0.0
33 Imports NFLD	0.0
34 Imports PEI	0.0
35 Imports NS	0.0
36 Imports NB	0.0
37 Imports QU	0.0
38 Imports ON	0.3

Sectors	Initial Sectoral Demand
39 Imports MN	8.6
40 Imports SK	24.6
41 Imports AB	0.0
42 Imports BC	16.2
43 Imports Terr	0.1
44 Imports Foreign	11.4
45 Other Leakages	0.0
46 Total Employment	0.0
47 Total	1000.0

Table 6.4: Estimated Type I Impacts of the Hypothetical Scenario on the SASS Region

Sectors	Output	GDP at Factor Cost	GDP at Market Price	Imports	Labour Income	Employment
1 Agricultural and related services ind.	308.4	134.4	136.6	33.5	15.3	6.2
2 Irrigated Agriculture	18.5	8.7	8.7	1.8	1.9	0.3
3 Feedlots/Confined Livestock Operations	1158.4	228.8	217.4	95.4	139.0	8.4
4 Fishing and trapping industries	0.0	0.0	0.0	0.0	0.0	0.0
5 Logging and forestry industries	1.5	0.6	0.6	0.1	0.4	0.0
6 Mining, quarrying and oil well industries	20.6	15.9	16.3	0.9	4.7	0.3
7 Petroleum & Natural Gas	28.9	16.2	16.6	1.3	3.1	0.4
8 Meat Slaughtering	3.6	0.4	0.4	0.2	0.3	0.0
9 Other Food Processing	41.3	6.0	6.1	2.0	2.5	0.2
10 Refineries	2.5	0.1	0.2	0.1	0.1	0.0
11 Other Manufacturing industries	155.7	53.8	54.5	26.3	24.4	0.5
12 Construction industries	28.4	10.0	10.4	4.9	8.7	0.1
13 Transportation and storage industries	57.0	30.7	32.1	2.8	19.2	0.4
14 Communication and other utility ind.	21.2	13.2	13.6	0.9	6.5	0.1
15 Other utilities	28.2	17.6	19.8	1.5	3.3	0.2
16 Wholesale trade industries	79.0	48.0	49.5	2.2	31.9	0.7
17 Retail trade industries	33.7	20.5	21.0	0.9	16.5	0.9
18 Finance, insurance and real estate ind.	85.1	52.0	59.4	1.2	25.3	0.2
19 Business service industries	56.2	35.2	35.7	1.2	29.7	0.7
20 Educational service industries	0.2	0.1	0.1	0.0	0.1	0.1
21 Health and social service ind.	0.9	0.7	0.7	0.0	0.5	0.1
22 Accommodation and food services ind.	10.5	4.8	5.1	0.4	3.7	0.2
23 Other service industries	9.7	6.6	6.7	0.3	5.3	0.2
24 Operating, office, cafeteria and laboratory supplies	44.8	0.0	0.0	24.5	0.0	1.0
25 Travel & entertainment, advertising & promotion	19.9	0.0	0.0	2.6	0.0	0.5
26 Transportation margins	35.0	0.0	0.0	2.7	0.0	0.3
27 Non-profit institutions serving households	0.7	0.5	0.5	0.0	0.5	0.0
28 Government sector	10.8	6.3	6.4	0.4	5.2	0.0
Exogenous Industry Direct	0.0	0.0	2.2	61.3	0.0	0.0
Total Impacts	2260.8	711.1	720.3	269.4	348.2	22.0

Table 6.5: Estimated Type II Impacts of the Hypothetical Scenario on the SASS Region

Sector	Output	GDP at Factor Cost	GDP at Market Price	Imports	Labour Income	Employment
1 Agricultural and related services ind.	320.4	139.6	141.9	34.8	15.9	6.4
2 Irrigated Agriculture	19.0	8.9	8.9	1.9	1.9	0.3
3 Feedlots/Confined Livestock Operations	1167.8	230.6	219.1	96.1	140.1	8.5
4 Fishing and trapping industries	0.0	0.0	0.0	0.0	0.0	0.0
5 Logging and forestry industries	2.1	0.8	0.8	0.2	0.6	0.0
6 Mining, quarrying and oil well industries	28.0	21.6	22.1	1.3	6.3	0.4
7 Petroleum & Natural Gas	39.7	22.2	22.7	1.7	4.3	0.5
8 Meat Slaughtering	13.3	1.5	1.5	0.8	1.1	0.1
9 Other Food Processing	50.8	7.4	7.5	2.4	3.1	0.3
10 Refineries	3.3	0.2	0.2	0.1	0.2	0.0
11 Other Manufacturing industries	200.6	69.3	70.2	33.8	31.5	0.7
12 Construction industries	35.0	12.3	12.8	6.1	10.8	0.2
13 Transportation and storage industries	85.6	46.1	48.1	4.2	28.8	0.7
14 Communication and other utility ind.	41.7	25.9	26.7	1.7	12.8	0.3
15 Other utilities	43.5	27.2	30.6	2.3	5.1	0.3
16 Wholesale trade industries	105.8	64.2	66.2	2.9	42.7	1.0
17 Retail trade industries	88.7	53.9	55.3	2.3	43.4	2.2
18 Finance, insurance and real estate ind.	242.1	147.9	169.0	3.5	71.9	0.5
19 Business service industries	84.4	53.0	53.6	1.8	44.6	1.1
20 Educational service industries	2.3	1.7	1.7	0.0	1.6	1.2
21 Health and social service ind.	11.6	8.3	8.5	0.4	6.5	0.7
22 Accommodation and food services ind.	52.6	24.2	25.8	2.2	18.7	1.2
23 Other service industries	21.4	14.5	14.8	0.6	11.6	0.5
24 Operating, office, cafeteria and laboratory supplies	61.2	0.0	0.0	33.5	0.0	1.4
25 Travel & entertainment, advertising & promotion	36.7	0.0	0.0	4.8	0.0	0.8
26 Transportation margins	40.2	0.0	0.0	3.0	0.0	0.3
27 Non-profit institutions serving households	11.0	7.3	7.5	0.2	6.9	0.3
28 Government sector	22.9	13.4	13.5	0.9	11.2	0.1
Exogenous Industry Direct	0.0	0.0	2.2	61.3	0.0	0.0
Total Impacts	2831.7	1002.2	1031.4	304.9	521.7	29.6

7 SUMMARY

Increasing pressure is being put upon planners to improve the quality of their decision making processes. Some of this pressure is in the form of justification of planning decisions, which results in a expanding need for information. Knowledge of regional economic system provides one avenue to supplement the need for better information for these purposes. Accounting models such as an input-output model offer a number of distinct advantages to the planning process to establish a regional information system. Regional accounts, if presented in a systematic manner, present the relationship between various links that exists in a complex regional economic system. This permits answering the question 'what needs to be known', rather than 'who needs to know'.

Economic growth or decay of a region is a complex of components or a number of changes that occur simultaneously or perhaps sequentially until a new equilibrium is reached. To understand such a process, use of a model, such as the input-output model, is helpful. Such models are used for structural planning, as is the case with the SASS regional economic development planning project. The SASSIE model presented in this report is designed to explain many complex issues that are raised during planning sessions. In spite of the limitations of the model, it remains to be widely used for the short run planning. With proper modifications, it can be adapted to long-tem planning as well.

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APPENDIX A

LIST OF SECTORS AND COMMODITIES IN THE ORIGINAL STATISTICS CANADA'S TRANSACTIONS TABLE

Table A.1: List of Sectors in Statistics Canada's Original Transactions Table, 1999

Sector No.	Sector Description
1	Crops and Animal Production
2	Forestry and Logging
3	Fishing, Hunting and Trapping
4	Support Activities for Agriculture and Forestry
5	Mining, Oil and Gas Extraction
6	Utilities
7	Construction
8	Manufacturing
9	Wholesale Trade
10	Retail Trade
11	Transportation and warehousing
12	Information and Cultural Industries
13	Finance, Insurance and Real Estate and Renting and Leasing
14	Professional, Scientific and Technical Services
15	Administrative and Other Support Services
16	Educational Services
17	Health Care and Social Assistance
18	Arts, Entertainment and Recreation
19	Accommodation and Food Services
20	Other Services (Excluding Public Administration)
21	Operating, Office, Cafeteria and Laboratory Services
22	Travel and Entertainment, Advertisement and Promotion
23	Transportation Margins
24	Non-Profit Institutions Serving Households
25	Government Sector

Table A.2: List of Commodities in Statistics Canada's Original Transactions Table, 1999

Commodity No.	Commodity Description
Intermediate Inputs	
1	Grains
2	Other agricultural products
3	Forestry products
4	Fish, seafood and trapping products
5	Metal ores & concentrates
6	Mineral fuels
7	Non-metallic minerals
8	Services incidental to mining
9	Meat, fish, and dairy products
10	Fruit, veg. and other food products, feeds
11	Soft drinks and alcoholic beverages
12	Tobacco and tobacco products
13	Leather, rubber, and plastic products
14	Textile products
15	Hosiery, clothing and a[illegible]ries
16	Lumber and wood products
17	Furniture and fixtures
18	Wood pulp, paper and paper products
19	Printing and publishing
20	Primary metal products
21	Other metal products
22	Machinery and equipment
23	Motor veh., oth. transport equip. and parts
24	Electrical, electronic and communic. prod.
25	Non-metallic mineral products

Commodity No.	Commodity Description
26	Petroleum and coal products
27	Chemicals, pharmaceuticals & chemical prod.
28	Other manufactured products
29	Residential construction
30	Non-residential construction
31	Repair construction
32	Transportation and storage
33	Communications services
34	Other utilities
35	Wholesaling margins
36	Retailing margins
37	Gross imputed rent
38	Other finance, insurance, and real estate services
39	Business and computer services
40	Private education services
41	Health and social services
42	Accommodation services and meals
43	Other services
44	Transportation margins
45	Operating, office, cafeteria and lab. supplies
46	Travel & entertainment, advertising & promotion
47	Non-profit institutions serving households
48	Government sector services
49	Non-competing imports
50	Unallocated imports and exports
51	Sales of other government services
Primary Inputs	
52	Indirect taxes

Commodity No.	Commodity Description
53	Subsidies
54	Wages and salaries
55	Supplementary labour income
56	Mixed income
57	Other operating surplus

Table A.3: Categories of Final Demand Included in the Statistics Canada's Original Transactions Table, 1999

Final Demand Category No.	Final Demand Category Description
1	Personal Expenditures on durable goods
2	Personal Expenditures on semi-durable goods
3	Personal Expenditures on non-durable goods
4	Personal Expenditures on services
5	Machinery and Equipment by Non-government Sectors
6	Machinery and equipment by Government Sector
7	Construction, excluding Housing, by Non-government Sectors
8	Housing Construction by Non-government Sectors
9	Construction by Government Sector
10	Inventories
11	Government Net Current Expenditures
12	Exports
13	Imports